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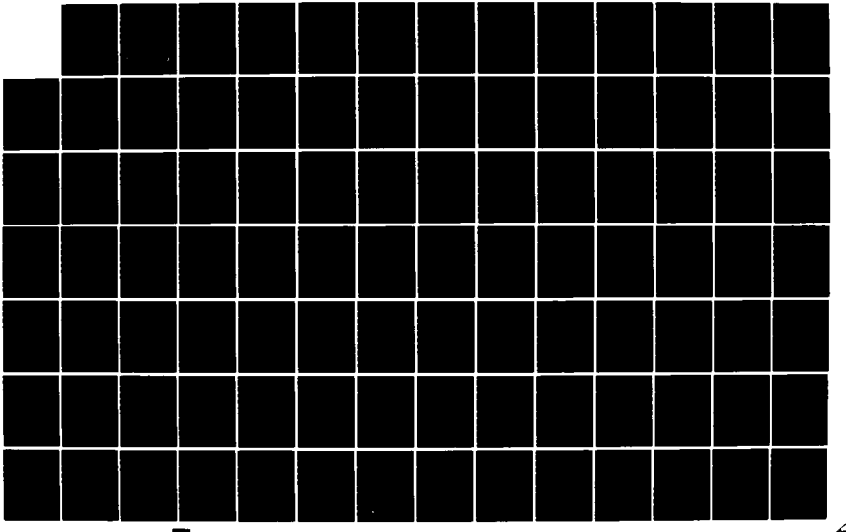

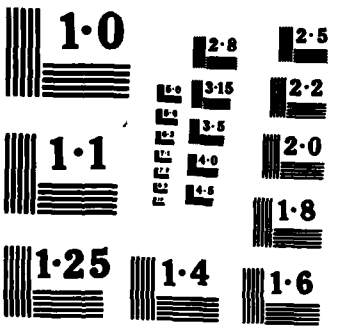
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Final

ENVIRONMENTAL STATEMENT

MAINTENANCE DREDGING OF CHARLESTON HARBOR, ASHLEY RIVER, AND U. S. NAVY CHANNELS IN COOPER RIVER CHARLESTON AND BERKELEY COUNTIES, SOUTH CAROLINA

"Original contains color plates: All DTIC reproductions will be in black and white"

U. S. ARMY ENGINEER DISTRICT
CHARLESTON, SOUTH CAROLINA

March 1976

SUMMARY

MAINTENANCE DREDGING OF CHARLESTON HARBOR, ASHLEY RIVER. AND U. S. NAVY CHANNELS IN COOPER RIVER, CHARLESTON AND BERKELEY COUNTIES, SOUTH CAROLINA

( ) Draft (X) Final Environmental Statement

Responsible Office: U. S. Army Engineer District, P. O. Box 919, Charleston, S. C. 29402 (AC 803-577-4171)

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: a. Charleston Harbor. Maintenance of a channel for commercial purposes 35 feet deep and 1,000 feet wide from the sea to the inner end of the jetties, thence 600 feet wide to the U. S. Navy Shipyard, and thence 400 feet wide to the mouth of Goose Creek, a total distance of 21.9 miles, with a turning basin 1,100 feet wide at the ports terminals; maintenance of a channel 35 feet deep and 500-700 feet wide through Town Creek reach; maintenance of a channel in Shem Creek 10 feet deep and 110 feet wide from a flared entrance from Hog Island Channel to and including a turning basin 130 feet wide and 400 feet long with the upper end 250 feet upstream from Mt. Pleasant public wharf, thence 10 feet deep and 90 feet wide to the U. S. Highway No. 17 bridge; maintenance of a channel 10 feet deep and 90 feet wide in Hog Island channel from Shem Creek to the Atlantic Intracoastal Waterway; dredging for above maintenance and disposal at various sites; and maintenance of two entrance jetties of stone on log mattress foundation.

b. Shipyard River. Maintenance of a channel 30 feet deep at mean low water and 200 feet wide, widened to 300 feet at the entrance from deep water in Cooper River to the vicinity of the Airco Alloys and Carbide Company, with a turning basin 30 feet deep opposite the Gulf Oil Corporation terminal, and another turning basin 30 feet deep at the upper end of the project with a flared entrance.

c. Ashley River. Maintenance of a channel 30 feet deep at mean low water and 300 feet wide from the mouth to the Standard Wharf, suitably widened at bends and at head of the improvement; and for maintenance to a depth of 12 feet and a width of 100 feet from the approach channel to the municipal yacht basin. This feature of the project is inactive.

d. Navy Channel. Maintenance of a channel of variable width 35 feet deep at mean low water in the channel of the Cooper River from the Army Ordinance Depot north approximately 18,000 feet to wharf "Alpha", Naval Weapons Station; maintenance of an area 400 feet by 3,050 feet by 37 feet deep adjacent to pier "Charlie"; and maintenance of an area 400 feet by 800 feet by 50 feet deep adjacent to the Submarine Floating Dry Dock Facility.

e. Navy piers and slips. Maintenance dredging performed by the U. S. Navy to maintain project depths of 35 feet and 20 feet in slips and in front of the piers for a distance of about 16,500 feet and periodic dredging necessary to maintain two submerged dredge lines.

3. a. Environmental Impacts of this Project include: Short-term increase in turbidity and sedimentation; smothering of plant and animal communities in disposal areas; temporary frightening of birds and mammals in the area; temporary reduction of phytoplankton and zooplankton; possible oxygen reduction due to disturbance of anaerobic bottom sediments; short-term reduction of benthic organism populations in the path of the cutterhead and in the offshore disposal area; increase in the local mosquito population; possible adverse effect on fish larvae due to increased turbidity; minor increase in air pollution during dredging operations; and stimulation of the local, state and national economy.

b. Adverse Environmental Effects include: Temporary increase in turbidity and siltation in the vicinity of the dredge and disposal areas; temporary decrease in primary production resulting from turbid waters; possible loss of organisms through leaching of toxic substances from upland disposal areas; possible reduction in dissolved oxygen levels as a result of the dredge disturbing organic materials undergoing anaerobic decomposition; possible displacement of wildlife species; alteration of existing vegetation in disposal areas; destruction of some benthic organisms by the cutterhead; and increase in the local mosquito population.

4. Alternatives:

a. No action

b. Combination of various dredging techniques and alternate disposal areas

5. Comments requested from:

U. S. Department of Interior
U. S. Environmental Protection Agency
U. S. Department of Commerce
U. S. Department of Commerce, Coastal Zone Management
Forest Service, USDA
Commander, Naval Base, Charleston, S. C.
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Federal Power Administration
U. S. Coast Guard
Soil Conservation Service, USDA
Federal Highway Administration, USDT
South Carolina States Ports Authority
S. C. Department of Parks, Recreation, and Tourism
South Carolina Wildlife and Marine Resources Commission
South Carolina Water Resources Commission
South Carolina Department of Health and Environmental Control

6. Draft Statement to CEQ 8 September 1975.

Final Statement to CEQ 8 March 1976.

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Final
Environmental Statement
Maintenance Dredging of Charleston Harbor, Ashley River,
and U. S. Navy Channels in Cooper River,
Charleston and Berkeley Counties,
South Carolina

Table of Contents

1.0. Project description.

1.01 Commercial channels.

1.01.1 Charleston Harbor. The Charleston Harbor project (Figure 1) provides for a channel for commercial purposes 35 feet deep and 1,000 feet wide from the sea to the inner end of the jetties (Figure 4), thence 600 feet wide to the U. S. Navy Shipyard, and thence 400 feet wide to the mouth of Goose Creek, a total distance of 21.9 miles (Figures 2 and 3), with a turning basin 1,100 feet wide at the Ports Terminals; and for a channel 35 feet deep and 500-700 feet wide through Town Creek; for a channel in Shem Creek 10 feet deep and 110 feet wide from a flared entrance from Hog Island Channel to and including a turning basin 130 feet wide and 400 feet long with the upper end 250 feet upstream from Mount Pleasant public wharf, thence 10 feet deep and 90 feet wide to the bridge on U. S. Highway No. 17; and for maintenance of a channel 10 feet deep and 90 feet wide in Hog Island Channel from Shem Creek to the Atlantic Intracoastal Waterway. The project also includes the maintenance of two entrance jetties of stone on log mattress foundation; the north jetty is 15,443 feet long and the south jetty is 19,014 feet long; the distance between their axis at the outer end is 2,900 feet. The project also provides for the following work, which was authorized to be prosecuted only as found necessary in the interest of national defense; a 40-foot channel, 1,000 feet wide from the sea to the inner end of the jetties, thence 600 feet wide to the south pier at the Navy Yard, and then 1,000 feet wide to the Commandant's wharf; and an anchorage area 30 feet deep between Castle Pinckney and Fort Moultrie. The project has been completed except for the 40-foot national defense project.

1.01.1.1 The Charleston Harbor project was authorized by the River and Harbor Act of June 18, 1878, and by subsequent acts of which the latest were dated October 17, 1940, March 2, 1945, September 3, 1954 and July 14, 1960. The total cost for new work in the harbor to date is $9,914,804. The total cumulative cost for maintaining the harbor to date is $36,075,261 with an average cost of $3,646,700 annually. The approximate quantity of dredged material removed from the harbor annually is about 10,491,000 cubic yards. Major shoal areas are shown on Figure 5. This material is deposited on several diked disposal areas (Figure 5) and in one offshore disposal area (Figure 4). The existing 35-foot project will require about 3,913 acres of disposal area during the next 50 years. A summary of maintenance dredging activities in the harbor is presented in Table 1.

1.01.2 Shipyard River. This project (Figure 6) provides for a channel 30 feet deep at mean low water and 200 feet wide, widened to 300 feet at the entrance, from deep water in Cooper River to the vicinity of the plant of AIRCO Alloys Company,

with a turning basin 30 feet deep opposite the Gulf Oil Corporation terminal and a turning basin 30 feet deep at the upper end of the project with flared entrance. Total project length is 1.2 miles.

1.01.2.1 The Shipyard River project was authorized by the River and Harbor Act of 3 July 1930, and by subsequent acts of 20 August 1935, 26 August 1937, and 2 March 1945. The Total cost for new work in Shipyard River to date is $491,974. The total cumulative cost of maintaining the channels as of 30 June 1974 was $5,230,027. The project was completed in June 1951.

1.01.3 Ashley River. The project (Figure 7) provides for a channel 30 feet deep at mean low water and 300 feet wide from the mouth to the Standard Wharf, a distance of 7.4 miles, suitably widened at bends and at the head of the improvement. The existing project was authorized by the River and Harbor Acts of 25 July 1914 and 26 August 1937.

1.01.3.1 The total cost for new work to date is $260,996 and the total cumulative cost for maintenance dredging was $449,317 as of 30 June 1972. This project was completed in 1940. The controlling depth at mean low water in June 1975 was 15 feet for a width of 300 feet from the mouth to the downstream highway bridge; thence 14 feet to the head of the project. This project is currently inactive.

1.02 U. S. Navy channels. In addition to maintenance of the Charleston Harbor Navigation Project, the Corps of Engineers maintains channels in the Cooper River for the U. S. Navy. This work consists of the following:

1.02.1 Dredging to a depth of 35 feet mlw in the channel of the Cooper River from the Army Ordinance Depot north, approximately 18,000 feet to wharf "Alpha", Naval Weapons Station (Figure 8). Approximately 1,200,000 cubic yards of material are removed and deposited annually with approximately 400,000 cubic yards being disposed of in the Clouter Creek disposal area and 800,000 cubic yards in the Yellow House Creek Disposal area.

1.02.2 Dredging twice annually an area 400 feet by 3,050 feet by 37-feet deep adjacent to Pier "Charlie" and an area 400 feet by 800 feet by 50 feet deep adjacent to ARDM site, Submarine Floating Drydock Facility (Figure 8). Approximately 215,000 cubic yards are removed and deposited annually in the Yellow House Creek disposal area.

1.03 U. S. Navy piers and slips. In addition to the maintenance dredging performed by the Corps, the U. S. Navy operates a hydraulic dredge to maintain adequate depths around slips and piers for the docking of Navy ships (Figure 9). The work consists

of periodic dredging of slips and in front of piers for a distance of about 16,500 feet. Approximately 2,730,000 cubic yards of material are removed and deposited in the Clouter Creek disposal area annually. Approximately once every eight years the Navy's submerged dredge lines crossing the Cooper River from piers D and F (Figure 10) are removed and replaced. Approximately 13,000 cubic yards of material yearly average is removed and deposited in the Clouter Creek disposal area.

1.04 Disposal areas. Under existing authority the local sponsor, the South Carolina State Ports Authority, provides easements for disposal sites. Even though maintenance dredging is performed yearly in the harbor, the Corps of Engineers cannot require the local sponsor to obtain disposal areas at a rate faster than required to meet immediate needs. The Corps can reject sites proposed by the local sponsor which it considers inadequate based on current needs and policy. The draft EIS stated in several places the desire of the Corps to use upland disposal sites and to discontinue use of marshlands after the sites now being used are filled to capacity. Regulations published by the Department of the Army, "Federal Projects Involving the Disposal of Dredged Material in Navigable Waters", 39 FR 26635-26641, 22 July 1974, further states the Corps' intention to discourage the use of wetlands and marsh as future disposal sites.

1.04.1 Interagency coordination meetings and field trips as necessary would be held prior to the selection of the disposal sites. These meetings would include EPA, U. S. Fish and Wildlife Service, South Carolina Wildlife and Marine Resources Department, and other cognizant agencies.

1.04.2 Entrance channel. Dredging of the entrance channel is accomplished by hopper dredge and the dredged material is deposited in an approved ocean disposal area (Figure 4) located approximately eight miles offshore at Latitude 32°38'38"N and Longitude 79°44'39"W in about 40 feet of water. This offshore site complies with EPA recommendations and was selected on the basis of recommendations of the South Carolina Wildlife and Marine Resources Department. Elutriate tests will be conducted on bottom sediments before next year's dredging.

1.04.3 Inner harbor. Dredging of the turning basin and the inner portions of the harbor is accomplished with an hydraulic dredge and a pipeline leading to disposal areas. Materials dredged from the harbor are placed in the Morris Island, Shem Creek, Daniel Island, Clouter Creek, and Yellow House Creek diked disposal areas. In the event that Plan 8 in Section 1.05 is proved feasible, most of these materials may be disposed in offshore disposal sites. Major shoaling areas and disposal areas are depicted on Figure 5. As existing disposal areas are used to capacity, new areas will be selected by the project sponsor, the State of South Carolina, on upland sites adjacent to the harbor. These areas will then be evaluated by the Corps of Engineers and the cooperative selection process described in Section 1.04.1 to determine their suitability from an engineering and environmental standpoint prior to acquisition by the project sponsor. The estimated dates when the capacity of these areas will be reached or when the current easement expires is as follows:

1.04.3.1 Daniel Island. Daniel Island is located at the junction of the Cooper and Wando Rivers and is currently under easement to the South Carolina State Ports Authority until 1980 or until such time that it is filled to an elevation of 18 feet above mlw. A total of 686 acres of the 789 acres under easement have been diked. Previous studies indicate that once the material is in the disposal area it will consolidate to about 50 percent of its shoal volume. Applying this factor to the current rate of filling, it is calculated that Daniel Island is being filled at a rate of about 1.6 feet per year. At this rate, 18.0 feet mlw will be reached after maintenance dredging in 1977. It has been recommended that the easement be amended to permit filling to 22 feet mlw thus extending the life of this area through 1980 and possibly beyond 1980. Due to the additional drying time that would be required before dikes could be raised, the District Engineer has asked the project sponsor (the State of South Carolina) to initiate steps to renew the Daniel Island easement, extending the time and deleting the restrictions on height of fill, and begin negotiations for an additional disposal area suitable for Lower Charleston Harbor maintenance requirements.

1.04.3.2 Morris Island. The Morris Island disposal area is located at the mouth of the harbor west of the entrance channel. A total of 703.5 acres are under easement to the South Carolina State Ports Authority for a period of 25 years from 21 December 1967. The diked area currently being used for disposal covers about 550 acres. Approximately 650,000 cubic yards of in situ material removed from the anchorage basin are placed in the Morris Island disposal area annually. The average elevation of dredged materials in the disposal area is about 7.0 feet mean low water (mlw). Assuming that the area can be filled to a maximum elevation of 23 feet mlw and that the dredged material has a compaction ratio of 2:1, the Morris Island disposal area has a capacity of about 14,328,000 cubic yards of compacted material or 28,656,000 cubic yards of shoal or in situ material.

1.04.3.3 Drum Island. Drum Island is located just south of Daniel Island and is bounded by Town Creek on the west and the Cooper River on the east (Figure 5). The Cooper River bridges pass over the southern portion of the island. The original 300 acre easement was for 5 years beginning 1 December 1968. The easement expired in 1973, however, the South Carolina State Ports Authority is renegotiating with the owner and anticipates that the area will be available for disposal in the near future.

1.04.3.4 Clouter Creek. The Clouter Creek disposal area is located on the east side of the Cooper River between Mile-11 and Mile-15. Approximately 1.8 million cubic yards of material dredged during Corps of Engineers maintenance dredging are placed in an 817 acre area on the north half of the island annually. A total of 1,050 acres is under easement to the South Carolina State Ports Authority. Of this total, 274 acres are under easement for 15 years from 26 September 1961 renewable through 25 September 1986 and 776 acres are under a perpetual

spoil easement from 10 September 1958. The average elevation inside the disposal area is currently about 11.0 feet mlw. Assuming that the area can be filled to a maximum elevation of 23 feet above mlw, and that the dredged material has a compaction ratio of 2:1, it is estimated that this portion of the Clouter Creek disposal area has a capacity of about 15,686,400 cubic yards of compacted material or 31,372,800 cubic yards of shoal or in situ material.

1.04.3.4.1 In addition to the area used by the Corps of Engineers, the U. S. Navy uses a 703 acre area on the southern portion of the island to dispose of materials removed during their maintenance dredging of docks and slips. Approximately 2.7 million cubic yards of dredged material are pumped into this area annually. Elevations inside the disposal area average about 15.0 feet mlw. Based on the assumptions made above, this area has a capacity of 8,998,400 cubic yards of compacted material or 17,996,800 cubic yards of shoal or in situ material.

1.04.3.5 Yellow House Creek. The Yellow House Creek disposal area is located on the east side of the Cooper River at about Mile-19. The South Carolina State Ports Authority has a total of 951 acres under perpetual easement from 10 September 1958. A total of 597 acres has been diked. Approximately 200,000 cubic yards of shoal material are pumped into this disposal area annually. The average elevation inside the diked area is currently about 8.0 feet mlw. The capacity of the diked area is about 14,328,000 cubic yards of compacted material or 28,656,000 cubic yards of shoal or in situ material based on the assumption that material can be piled to a maximum height of 23 feet mlw and has a compaction ratio of 2:1.

1.05 Special studies. Under the aforementioned authorizations, the following studies were conducted:

a. Long-range disposal of dredged material: During the conduct of this study of long-range disposal of dredged material, eight plans were evaluated to determine feasibility and costs of meeting the dredging requirements of the existing project as well as related projects for a 60-year period, 1965 to 2024. Cost estimates were prepared for maintaining the navigation features located upstream of and including the anchorage basin for the current maintenance method and nine alternate plans. An estimate of cost for maintenance dredging utilizing the current practice (pipeline dredge and harbor-side disposal areas) was prepared for a 100-year period of analysis and adopted as the base to which the relative merits of the various alternate methods were compared monetarily. The considered dredging and disposal plans are summarized as follows:

Plan 1 - Removal of shoal material by pipeline dredge to a permanent land disposal area adjacent to the harbor - that is, continuing the present dredging and disposal method.

Plan 2 - Removal of shoal material and conveying it to a disposal area at sea, all by hopper dredge.

Plan 3 & 3A - Removal of shoal material by pipeline dredge, placing it in one intermediate disposal area, then conveying it to sea by pipeline, by diesel powered booster stations (Plan 3) or electrically powered booster pumps (Plan 3A).

Plan 4 & 4A - Removal of shoal material by pipeline dredge, placing it in two intermediate disposal areas, then conveying it from the intermediate disposal areas to sea by pipeline, by diesel powered booster pumps (Plan 4) or electrically powered booster pumps (Plan 4A).

Plan 5 - Removal of shoal material by pipeline dredge, placing it in an intermediate disposal area, then conveying it by barge to sea.

Plan 6 - Removal of material by pipeline dredge placing it in intermediate disposal areas, then conveying it from these areas to remote inland disposal areas by pipeline.

Plan 7 - Removal of material by pipeline dredge, placing it in an intermediate disposal area, then conveying it from this area to remote inland disposal areas by truck.

Plan 8 - Removal of shoal material by a special dredge designed to utilize barges, and the use of these barges to convey the material directly to sea.

b. Estuarine values study: In order to evaluate (1) the plans considered in the long-range dredging and disposal study beyond a strictly monetary comparison of plans, and (2) the environmental effects of recommended improvement and/or modifications to the existing navigation project, the Corps requested the Bureau of Sports Fisheries and Wildlife to accomplish the estuarine values study evaluating the effects of the foregoing on fish and wildlife resources. To aid the Bureau of Sports Fisheries and Wildlife in their evaluations, the following special studies were contracted for and funded by the Corps of Engineers: (1) evaluation and interpretation of bottom sediment samples, (2) physical and chemical identification of bottom sediments, (3) bioassay studies, and (4) inventory and evaluation of marshlands and potential offshore disposal areas.

Based on these special contracted studies and the Corps' long-range disposal study, the Bureau of Sport Fisheries and Wildlife made the following recommendations concerning dredging and disposal practices:

1. Disposal of dredged material within the confines of the harbor or its adjacent marshlands be discontinued;

2. The most desirable method of disposing of dredged material from an ecological basis is at sea via special dredge and barge (Plan 8). Further, implementation is conditional to the favorable findings of a small scale pilot program indicating the dredged material can be properly transported and disposed of at sea; and

3. The most desirable alternative to sea disposal environmentally would be disposal in diked areas located inland above the marshes. The best plan accomplishing both the economical and environmental considerations would be Plan 6 of the long-range disposal study.

1.06 Relationship to other projects. The relationship of the Charleston Harbor Project to the Cooper River Rediversion Project is discussed in Section 2.03.1 The relationship of the Charleston Harbor Project to other Federal, State or local government projects varies from a lack of any significant relationship to some form of enhancement. There is no direct relationship between the proposed project and the AIWW since the dimensions of the latter are considerably less than that of the existing harbor. Maintenance of the harbor has no potential of interacting with projects of other agencies except for that aspect associated with the disposal of dredged material. In this regard, there is no consideration given to the use of such areas for disposal of dredged material. Examples of such projects are Forts Sumter and Moultrie of the National Park Service and Hog Island which is the site of a proposed naval museum.

2.0 Existing Environmental Setting.

2.01 General. Charleston Harbor is located at about the midpoint of South Carolina's Atlantic Coast, 140 statute miles southwest of the entrance to Cape Fear River, North Carolina, and 75 miles north of Savannah Harbor, Georgia. The lower harbor is formed by the confluence of Ashley, Cooper and Wando Rivers. Vast tidal marsh areas lie on either side of the entrance to Charleston Harbor. Those to the northeast separate the barrier islands from the mainland and are intersected by the Intracoastal Waterway and numerous tidal streams. Those to the southwest back Morris Island, a rapidly eroding barrier island, and are found on the southeastern side of James Island. Docking and maintenance facilities of the harbor are concentrated along the west shore (right descending side) of Cooper River extending from Battery Point of peninsular Charleston to the mouth of Goose Creek at mile 15.7, the upstream limit of authorized Federal projects. The locality is shown on U. S. Coast and Geodetic Survey Charts 470 and 1239, and on Figure 1 of this report.

2.01.1 The harbor covers an area of approximately 14 square miles with depths ranging between 10 and 25 feet at mean low tide except within project channels which are dredged to a depth of 35 feet. The harbor is faced with a serious shoaling problem that is principally due to the Santee-Cooper Project which was constructed by the South Carolina Public Service Authority in 1942. Prior to this time, the lower harbor required little maintenance dredging and natural depths in some areas ranged up to about 75 feet.

2.02 Tributary waters. Tributary waters in the Charleston Harbor area include the Ashley, Cooper, Wando and Shipyard Rivers, Shem Creek, and Hobcaw Creek.

2.02.1 Ashley River. The Ashley River is a small coastal plain stream having its origin in headwater swamps. The average fresh water inflow from the Ashley is 261 cfs with a drainage area of approximately 350 square miles. Flowing generally southeastward, its lower reach forms the west short of peninsular Charleston. The Ashley River is urbanized along a large portion of its shoreline.

2.02.2 Cooper River. The Cooper River Basin comprises 720 square miles of coastal plain in South Carolina. The Cooper River has its origin at the confluence of its East and West Branches (locally termed "The Tee") from which it flows 32 miles southward to its outlet in Charleston Harbor. The East and West Branches of the Cooper River extend some 20 miles inland in a northward direction to their origins as small ill-defined channels in a low-lying area of Berkeley County known as Ferguson Swamp. Lake Moultrie in the upper part of the Cooper River Basin was constructed by the South Carolina Public Service Authority in 1942 as part of the Santee-Cooper Project.

This lake intercepts drainage of about 300 square miles of the Cooper River Basin. Except for short intervening reaches, the west bank of the Cooper River is lined with Federal, State, and private docking facilities.

2.02.3 Wando River. The Wando River is a small coastal stream having a watershed of about 120 square miles and an outlet in the eastern part of Charleston Harbor. The lower Wando River is bordered by a rather large expanse of salt marsh which in turn is bordered by scattered residences and subdivisions. The extent of marshes diminishes with distance upstream and the extent of woodland increases until the uppermost part of the Wando is entirely in woodlands.

2.02.4 Shipyard River. Shipyard River, a small tidal tributary about two miles in length, extends in a southeastward direction along the southwest boundary of the U. S. Naval Reservation to Cooper River at a point opposite the southern tip of Daniel Island at mile 8.7. Docking facilities are located along the west shore of the lower mile of channel, while the east shore is bounded by tidal marshland along its entire length.

2.02.5 Shem Creek. Shem Creek is a small tidal tributary which extends in a southwestward direction to Charleston Harbor at mile 4.0. The City of Mount Pleasant is located to the southwest and new residential areas are being developed along the northwest shore. The lower reach, that reach downstream of U. S. Highway 17, is used as a base for essentially all commercial fishing vessels operating out of Charleston Harbor.

2.02.6 Hobcaw Creek. Hobcaw Creek is a small tidal tributary which extends in a westerly direction and enters the Wando River about one mile from its confluence with the Cooper River. The city of Mount Pleasant is located to the south and residential areas are developing along the southern shore. Large areas of tidal marshlands line the shore for much of its length.

2.03 Other Federal projects.

2.03.1 The Atlantic Intracoastal Waterway (AIWW). Charleston Harbor forms part of the route of the Atlantic Intracoastal Waterway. One section of the waterway extends southwestward from Winyah, S. C., to Charleston Harbor through the Sullivans Island Narrows, and another section extends from the harbor by way of Wappoo Creek, a tributary of the Ashley River, southwestward to Beaufort and Port Royal, S. C. The existing project provides for a channel 12 feet deep at mean low water and not less than 90 feet wide.

2.03.2 Cooper River Rediversion Project. This project was authorized by the Rivers and Harbors Act of 1968 (Public Law 90-483, 90th Congress, S. 3710, 13 August 1968) and provides for

the construction of a rediversion canal from the northeast portion of Lake Moultrie to the Santee River near Lake Mattassee and construction of a powerhouse, fish lift, and fish hatchery. The rediversion canal will be about 11.5 miles in length and will consist of a 2.5 mile entrance channel in Lake Moultrie, an intake canal about 4.0 miles long and a tailrace canal about 5.0 miles long. Rediversion will decrease the average discharges through the Pinopolis Dam to about 3,000 cfs and will increase average flows in the Santee River. The purpose of the project is to "redivert" the major portion of the waters from the Santee basin from the Cooper River to the Santee River thereby effecting the reduction of harbor shoaling and related costly dredging operations in Charleston Harbor. A discussion of the Charleston Harbor shoaling problem is presented in the following paragraphs.

2.03.2.1 Prior to the completion of the Santee-Cooper project by the State of South Carolina in 1942, Charleston Harbor was considered one of the finest natural harbors on the Atlantic Coast with depths in many areas exceeding 70 feet. After completion of the diversion project, the rate of shoaling rapidly increased and silt began to accumulate in all parts of the harbor. As a result, annual maintenance dredging requirements increased from less than 500,000 cubic yards up to approximately 10,000,000 cubic yards. Because of this shoaling problem, the Charleston Harbor estuary has been subject for many years to water quality changes and associated dredging effects. Beginning in 1942, a phenomenal increase occurred in the rate of shoaling in Charleston Harbor. Deposits of black muck material began to settle in the harbor and large shoals began to form in the project channels. Comprehensive studies conducted by the Corps of Engineers revealed that most of this shoaling was directly related to operation of the Santee-Cooper development which increased the average discharge in Cooper River from 72 cfs at Pinopolis to about 15,600 cfs. Most of the material creating these shoals was found to be of piedmont origin and only a small amount was found to be attributed to bank erosion. The increased freshwater flow has resulted in the formation of density currents in the harbor having a predominate upstream bottom flow which traps sediment within the harbor.

2.03.2.2 The increased shoaling rate has created two major problems: (1) an enormous increase in the cost of maintaining project depths by dredging; and (2) an increase in the rate of depletion of available disposal sites within the harbor area.

2.03.2.3 Prior to this increased shoaling rate, materials removed during maintenance dredging were placed in deep water areas of the harbor convenient to the site of dredging. This practice was continued for a time after shoaling became severe until it became evident that much of the sediment remained in suspension for a time and then drifted back into the channels. As a result, a policy of diking land areas for containment of dredged materials was established to reduce reshoaling and costs. The heavy shoaling rates which have prevailed over the past several years have resulted in a severe depletion of areas in which to deposit dredged materials. Cancellation of certain disposal area easements and the short-term nature of other easements, together with the continued heavy shoaling rate, combine to intensify the seriousness of the disposal area situation.

2.03.2.4 Most disposal areas are used over a period of years, so an estimate of the annual need for disposal areas is meaningful only if considered over a number of years. Based on estimates of annual dredging rates for average freshwater inflows of 15,600 and 3,000 cfs (Table 2), the future demand for disposal areas will be about 413 acres annually without rediversion and about 124 acres annually after rediversion. An additional 49 acres would be needed annually over the 50-year project life if the Charleston Harbor Deepening Project is implemented after rediversion. These acreages are based on the assumption that the compaction ratio of dredged material will be 2:1 and that the disposal areas will be used until the dredged material accumulation is approximately 15 feet deep.

2.03.2.5 The quantities listed under 3,000 cfs in Table 2 may not be achieved until about 10 years after the project is implemented. This time-lag is anticipated because the entire harbor contains silt deposits and as silt is removed from the harbor channels during maintenance dredging, silt deposits outside the channel will tend to move laterally into the channel. The annual maintenance requirements will increase slightly if the harbor is deepened as proposed.

2.03.3 Charleston Harbor Deepening Project. The recommended plan of improvement consists of the deepening of the entrance channel to Charleston Harbor from a depth of 35 feet to a depth of 42 feet and the extension of this channel from Mile -10.4 seaward to the 42-foot depth contour (Mile -11.2); deepening the existing harbor channels from a depth of 35 feet to a depth of 40 feet from the Entrance Channel (Mile 0.6) to Mile 15.7 at Goose Creek; deepening of the Shipyard River channel from 30 feet to 38 feet; enlargement of the upstream and downstream turning basins in Shipyard River to provide a 1,000 foot diameter turning area and to widen the connector channel between the two basins to 250 feet; enlargement of the anchorage basin near the harbor mouth by deepening to a depth of 40 feet and by extending the south side by 1,400 feet; enlargement of the turning basin at the head of the commercial channel at Goose Creek; dredging a new turning basin adjacent to the Columbus Street docks; widening the North Charleston and Filbin Creek reaches to 500 feet; easing the bend at the intersection of the channel and Wando River; and the relocating of channels near terminals to provide 125-foot clearance between piers and the edge of the channel.

2.03.3.1 Of the total 27,077,000 cubic yards of material to be removed from the Federal project area, 12,095,000 cubic yards from the entrance channel are scheduled for open water disposal in a currently used offshore area, 2,383,000 cubic yards from the turning basin would be placed in the currently used disposal area on Morris Island and 12,599,000 cubic yards from the inner harbor would be placed on upland areas on and northward of Daniel Island.

2.03.3.2 Approximately 1,110 acres of diked upland disposal area would be needed for the deepening project and about 49 acres (20 acres for Charleston Harbor and 29 acres for Shipyard River) would be needed on an annual basis during the 50-year economic life of the project for disposal of the additional shoal material (approximately 1,737,000 cubic yards annually) expected to be generated as a result of the harbor deepening.

2.04 Non-project associated facilities. There are 20 commercially important installations of wharves, docks, and piers, both public and privately-owned along Charleston Harbor. These installations have approximately 14,765 linear feet of berthing space and 632,000 square feet of transit shed area. There are also 50 acres of open storage areas plus 305 steel storage tanks having a total capacity of approximately 8,600,000 barrels. The harbor is broken down into six important commercial areas. These are the Union Pier Terminal, Columbus Street Terminals, Shipyard River Terminal, North Charleston Terminals, Port Terminal facilities and Wando River Terminals.

2.04.1 In addition to the commercial terminals, a large number of government-owned wharves are located on Cooper River, including the Navy Fleet landing, the wharves at the Navy Yard and Minecraft base, the Charleston Army Depot and the Naval Weapons Station. The U. S. Navy also has modern facilities for repair and overhaul of naval vessels including nuclear submarines.

2.04.2 South Carolina State Ports Authority permit application. The South Carolina State Ports Authority has applied for a Corps of Engineers permit to dredge, fill, and construct a marine terminal in the Wando and Cooper Rivers. The proposed work on the Wando River consists of the construction of a 135' X 5000' concrete wharf, supported by prestressed concrete piles, with a sheet steel bulkhead to the rear of the wharf; ten (10) cranes (8 container cranes and 2 gantry cranes) will be constructed on the wharf; a 12' X 350' prestressed concrete pile supported railroad trestle; and a barge slip with two (2) 12' X 220' prestressed concrete docks, 42' apart, will also be constructed on the site. The area to be dredged is approximately 5600' in length, with widths varying from 125' to 500', to a depth of -40.0' mean low water. Approximately 4,695,000 cubic yards of material are to be removed by hydraulic dredging of which 3,780,000 cubic yards of unsuitable material (silt and mud) will be deposited in the Morris Island Disposal Area and 915,000 cubic yards of suitable material (sand) will be deposited on the terminal site behind the bulkhead as fill. The plans for the proposed work on the Cooper River consist of a barge slip with two (2) 12' X 200' prestressed concrete docks, 42' apart, and the hydraulic dredging of an area, 1420' X 100', to a depth of -25.0' mean low water. Approximately 250,000 cubic yards of unsuitable material (silt and mud) will be deposited in the Daniel Island

Disposal Area, if available; if not, this material will be deposited in the Morris Island Disposal Area. A 100' section on the landward end of the coal tipple is to be removed with the debris being trucked away in accordance with all applicable laws. The purpose of the proposed project is to expand the existing South Carolina State Ports Authority facilities.

2.04.2.1 The operation of the proposed terminal is dependent upon the construction of a navigation channel in the Wando River from the Cooper River to the site of the proposed terminal. Extension of the Federal navigation project in Charleston Harbor to serve the proposed terminal will be considered by the Corps of Engineers if a permit is issued for the proposed work and a commitment for construction is made. In the event this extension is not approved as a Federally authorized project, the construction of the required navigation channel in the Wando River will be the responsibility of the applicant and subject to a subsequent Department of the Army permit action. Approximately 3,400,000 cubic yards of material would have to be removed to construct such a channel extension and its associated turning basin.

2.04.2.2 It is estimated that annual maintenance dredging required for the Wando terminal would be 150,000 to 200,000 cubic yards. An additional accumulation of 500,000 to 600,000 cubic yards of sediment may have to be dredged annually from the channel extension. Disposal of these quantities would require about 200 to 250 acre feet of disposal area annually.

2.05 Tides. The mean range of tide in the harbor is approximately 5.2 feet with spring and neap tides ranges of about 7.5 feet and 4.2 feet, respectively. Maximum current velocities in the harbor for normal conditions are about 4.0 to 5.0 feet per second at the surface and somewhat less at the bottom. The presence of a salinity differential between top and bottom strata of the harbor causes the bottom flood currents to predominate over the bottom ebb currents, relative to velocity and duration. Thus, the resulting upstream movement of bottom currents within the harbor constitutes an effective sediment trap, preventing sediment transports to the sea and causing the buildup of extensive shoals. The tidal prism is about 350,000 acre-feet.

2.06 Geology of South Carolina coastal plain.

2.06.1 General. The Charleston estuary, the Ashley, the Cooper and the Wando Rivers lie on the extreme southwest flank of the northwesterly trending Great Carolina Arch. The uplifting of the Great Carolina Arch after the Oligocene Cooper Marl and prior to the Miocene Duplin Marl depositions brings Cretaceous Age beds close to the surface along the North and South Carolina Border. To the northeast and southwest of this arch, the Early Eocene Black Mingo formation, the Middle Eocene Santee limestone, the Oligocene

Cooper Marl, and the Early Miocene Harthorne formation subcrop under a veneer of late Miocene and Recent Age sediments as represented on the southern flank of South Carolina below the Santee River.

2.06.2 Sedimentary formations. The sedimentary formations of the Coastal Plain range in age from Late Cretaceous to Recent and consist, for the most part, of unconsolidated sand, clay, gravel, marl, and limestone that has been deposited on a surface of granite, schist, and gneiss similar to (and a continuation of) the rocks underlying the adjoining Piedmont Province.

2.06.2.1 Underlying the Pamlico Marine terrace in the vicinity of Charleston Harbor are sediments Eocene age, represented by the Cooper Marl, and the Pleistocene age, represented by the surficial sedimentary deposits.

2.06.2.2 The Cooper Marl formation is the lower of the two sedimentation deposits. It has a thickness of approximately 226 feet in the vicinity of Charleston (USGS - open file) and is a sandy calcareous bed, about 75% calcium phosphate, the latter usually concentrated in black nodules the size of fine gravel. The marl is essentially a uniform formation, deposited in marine waters over 100 feet deep, and later subjected to several periods of subaerial erosion that left a surface sculptured with shallow valleys and depressions. The Pleistocene sands and gravels were deposited in these valleys and depressions during the recent glacial periods and are closely associated with the Cooper Marls. Underlying the Cooper Marl, in an abrupt contact, is the Santee Limestone formation.

2.06.2.3 On the top of this sedimentary formation lies the Pamlico terrace, which consists chiefly of fine sand and blue or gray clay. The sand is composed chiefly of quartz, but includes a little mica and a few dark minerals. It is sometimes referred to as "Wando Sand". The total thickness of the formation is reported to be about 60 feet. Fossils are generally the same marine mollusks that currently inhabit the littoral zone along the Carolina coast (Reference 1).

2.06.2.4 Between the blue-gray clay and the Cooper Marl a fine-to-medium sand is often found with some broken shells and occasional thin layers of blue-gray clay. This earlier beach deposit is called "ten-mile sand" (Reference 1).

2.06.3 Seismicity. From past earthquake records, it appears that the Charleston area experiences a seismic event of moderate intensity with a frequency of one every ten years. It is estimated that the Charleston area can expect a moderate to severe earthquake every 75 to 100 years. Of 438 earthquakes reported in South Carolina between 1754 and 1971, 402 have been in the Charleston-Summerville area with the remaining 36 shocks forming a southeasterly trending zone of activity that is transverse to the structural grain of the Applachians. Until about 1950, seismic activity in the state

was concentrated in the Charleston-Summerville area, but subsequent to that time activity has been primatily outside this locale (Reference 2).

2.06.4 Soils. Soils show considerable variation within the project area. The narrow beach fronting on the Atlantic Ocean consists mainly of sand and shell fragments with a smaller amount of silt. Most of the ocean beaches in the project area are eroding due to the action of waves and longshore currents. Inland from the barrier beach zone to the normal upstream limit of saltwater intrusion (3 feet msl) is a tidal marsh with soils comprised of dark loams, clays and mucks or peat and medium to high organic content. If drained, these tidal marsh soils may develop into an extremely acidic plastic clay known as "cat clay". Soils in this condition will not support plant life and are difficult to reclaim. Extending inland from the marsh for about 10 miles are a group of poorly drained soils occupying areas that are generally below 15 feet msl. These soils generally have dark grayish surface layers and dark sandy clay loam to sandy clay subsoils. Further inland on higher elevations in gently rolling areas are dark sandy loams with clay subsoils that are moderately well drained. On more level areas such soils may be poorly drained.

2.06.5 Mineral Resources. There is no significant commercial production of mineral resources in the project area. The Charleston area, however, was formerly the most productive area of phosphate in the state. The phosphatic material, a common marine phosphate known as carbonate-fluorapatite, is phosphatized Cooper marl reworked into the lower part of the Ladson formation. Phosphate mining in the area has been insignificant since 1920 and ceased entirely in 1938 (Reference 4). In addition to the above-mentioned phosphate, the only other minerals of possible economic value are marl, clays, sand and gravel (Reference 5).

2.07 Nature of Charleston estuary bottom sediments.

2.07.1 General. Examination of physical size characteristics of Charleston Harbor bottom sediments indicates several major sediment types deposited within the Charleston estuary. These include a longshore drift and continental shelf sand component being deposited over the major part of the estuary itself, and Holocene sand bars present within the landward rivers. Components can be delineated by plotting a variety of parameters associated with the size analysis. For this report they are illustrated by Figure 11 in which samples with less than 25 percent silt and clay (dominantly fine to medium sand) are mapped together with samples containing more than 75 percent silt and clay. The sand-silt dividing line is taken at .062mm. The longshore drift shelf sand is concentrated both in the vicinity of the harbor mouth where it grades seaward into continental shelf sands as well as along the north half of the estuary to the vicinity of Mt. Pleasant. Bottom samples obtained in the vicinity of the jetties and landward between Ft. Sumter and Ft. Moultrie contain over 90 percent sand size materials. Landward of these locations the sand

fraction is intermixed with silt and clay with the content of silt and clay increasing abruptly toward the west and more gradually toward the north.

2.07.1.1 Sand also occurs in bottom sediments in the Wando and Cooper Rivers as indicated in Figure 11. The accumulations here are related to Holocene and Recent channel deposits. In the Ashley River, similar deposits occur at depth, but surficially are buried by Recent silt and clay.

2.07.1.2 Between the two sand components the floor of the estuary is covered by dark-gray sludge composed of more than 75 percent silt and clay. Within the area of occurrence of the sludge indicated in Figure 11, there is no apparent relationship between physical size characteristics and water depth nor harbor currents. It is assumed that the silt-clay fractions are present in flocculated state such that their aggregated masses behave physically as much coarser particles.

2.07.2 Chemical characteristics of bottom sediments. The study of the chemical characteristics of bottom sediments was conducted by the Environmental Protection Agency during March, 1971. The Charleston District obtained 41 bottom samples from sites selected by an EPA representative. The sample locations are shown in Figure 12. The samples were all shipped in a frozen condition to EPA where they were analyzed for volatile solids, oil and grease, organic nitrogen, total kjeldahl nitrogen, total phospherous, chemical oxygen demand, heavy metals, and radioactivity. The results of their analysis are presented in Table 3.

2.07.2.1 EPA concluded that all sediments upstream of a line from Sullivans Island to Cummings Point should be disposed of on upland areas (above highwater mark), and sediments located seaward of this line should be removed by hopper dredge with disposal far enough from shore to prevent fine particles in the sediment from reaching marsh areas. However, in view of the new regulations governing disposal of dredged materials in open waters in the ocean these conclusions may no longer be valid. The new regulations, dated 15 October 1973, are more lenient with regard to ocean disposal and may allow for open water discharge of sediments from parts of the inner harbor. Chemical testing to determine if additional materials can be placed in the existing offshore disposal area will be initiated in the near future. If the results of these tests indicate that inner harbor sediments qualify for ocean disposal, this method of disposal will be used in those areas where it is economically feasible. See Section 1.05.

2.07.2.2 In a more recent study of bottom sediments (Reference 6), the South Carolina Water Resources Commission collected samples from the Ashley River, Cooper River, Intracoastal Waterway, Wando River, and Stono River for analysis by the Laboratory Services Branch of the South Carolina Pollution Control Authority. The results of their study are presented in Table 4. Station locations in the Cooper, Ashley, and Wando Rivers are shown on Figures 13, 14, 15, 16, and 17.

2.07.3 Pesticides in bottom sediments. As part of the above study (Reference 6), the U. S. Geological Survey collected and analyzed Cooper River bottom sediments for pesticide content. The

results of this study are presented in Table 5. Although pesticide levels appeared to be rather low at most stations, it should be noted (see footnotes to Table 5) that the ubiquitous polychlorinated biphenyl (PCB) compounds were detected in high enough concentrations to interfere with the determination of pesticide levels in all but three samples.

2.08 Hydrology. Charleston Harbor is normally stratified by salinity, with the surface layers being much fresher throughout most of the harbor. Extended periods of high river flow in the Cooper River cause the ocean water in the vicinity of the harbor mouth to become diluted with the result that the water entering the harbor during flood tides has a lowered salinity.

2.08.1 As mentioned previously, the three major rivers which are tributary to Charleston Harbor are the Ashley, the Cooper, and the Wando. The Cooper River is the most important tributary in that it provides the major source of inflow. The Cooper was originally a relatively small coastal plains stream having a watershed of 720 square miles. Its average flow at the "Tee", the confluence of its East and West Branches where most of its inflow had been received, was about 72 cfs. The diversion by the South Carolina Public Service Authority in 1942 of a part of the Santee River's flow into the Cooper River basin for hydropower generation increased the average flow of the Cooper River to 15,600 cfs. Discharge data for the Pinopolis powerplant are presented in Table 6.

2.08.2 Groundwater. A compilation of existing data on ground water was recently prepared by the U. S. Geological Survey in cooperation with the South Carolina Water Resources Commission (Reference 7). The USGS found that the aquifers in the area may be divided into unconfined aquifers, those in which the water producing sediments are not bounded by impermeable material, and confined aquifers which are bounded. In many cases unconfined aquifers and surface drainage are parts of one system and there is an hydrologic interchange of water between the confined and unconfined aquifers. Most of the dry-weather flow in many streams may be rejected recharge of confined aquifers underlying the area.

2.08.2.1 Unconfined aquifers. The shallow unconfined aquifers in the area occur in outcrops of southeastward dipping rocks of marine origin, surficial dune, beach sands, and possibly some old filled stream channels. The principal use of unconfined aquifers in the area is on some of the coastal islands where water systems utilize a freshwater lens floating on salt water in beach and dune sands. Although systems such as these have been successfully used for years on these islands they have limited use as sources of a large supply of fresh water. Their dependence on timely rainfall for recharge makes them particularly vulnerable to encroachment of salt water during extended dry periods. They are also very vulnerable to contamination from the surface.

2.08.2.2 Confined aquifers.

2.08.2.2.1 Cooper Marl. Shallow confined aquifers may be present where the Cooper Marl of Oligocene Age occurs or where the old stream channels were bounded by relatively impermeable sediments. The use of these aquifers is very limited.

2.08.2.2.2 Santee Limestone. The Santee Limestone of Middle Eocene Age is widely used as an aquifer in the study area. Wells completed in the Santee Limestone yield about 200 to 500 gallons per minute (gpm) and range in depth from less than 50 feet (15m) to about 500 feet (152m) in the vicinity of Charleston.

2.08.2.2.3 Black Mingo Formation. Producing wells within the aquifers of this formation range from about 100 feet (30m) in the northern part of the area to more than 500 feet (152m) in the Charleston area. Yields from these wells vary from a few gallons per minute to several hundred gallons per minute.

2.08.2.2.4 Peedee and Black Creek Formations. These formations are Late Cretaceous in age and lithologically are similar, so much so that they are undifferentiated in most logs. The depth to the top of the Peedee ranges from about 150 feet (46m) in the northern part of the area to about 700 feet (213m) in the Charleston area. The thickness of the Peedee Formation varies slightly but is generally about 400 feet (122m). The Black Creek Formation unconformably underlies the Peedee Formation and the depth to the top is about 550 feet (168m) in the northern part of the area to about 1,000 feet (305m) at Charleston. The Black Creek Formation thickens considerably coastward, ranging from about 550 feet (168m) in the northern part of the area to more than 1,000 feet (305m) at Charleston.

2.08.2.2.4.1 The water producing zones in the Peedee Formation have low transmissivities and yield small amounts of poor quality water, especially along the coast. Water from wells greater than 700 feet (213m) in depth generally has chlorides in excess of 500 mg/1. The major producing aquifer in the Black Creek Formation is a coarse sand near the bottom of the formation. Other minor water producing sands occur in the upper part of the formation but the water is of questionable quality.

2.08.2.2.5 Tuscaloosa Formation. The Tuscaloosa Formation of Early Late Cretaceous Age is a regional aquifer in much of the Coastal Plain of the state and unconformably underlies the Black Creek Formation. The top of the Tuscaloosa ranges from about 1,000 feet (305m) in the northern part of the area to more than 2,100 feet (640m) in the Charleston area.

2.09 Water Quality.

2.09.1 Charleston Harbor. The water quality of Charleston Harbor is similar to that of the Ashley, Cooper, and Wando Rivers from which it is formed. According to the latest state classifications, Charleston Harbor is classified as SC and is not suitable for swimming or the harvesting of oysters for market purposes. The water quality of the outer harbor is usually higher because of the diluting effect of the ocean. Recently constructed waste treatment facilities along the lower Cooper and Ashley Rivers have led to an improvement in the water quality of the harbor from the condition described in the Federal Water Pollution Control Administration report of 1966 (Reference 8). A trend of continued improvement in water quality is expected as a result of these facilities and others in the planning or construction stage. Recent water quality data collected by the South Carolina Department of Health and Environmental Control are presented in Table 7.

2.09.2 Cooper River. The water quality of the Cooper River is generally good but according to the latest state classifications, that portion of the river from U. S. Highway 52 to a point approximately 30 miles above the junction of the Ashley and Cooper Rivers is classified as Class B (waters suitable for domestic supply after complete treatment in accordance with requirements of the South Carolina State Board of Health, also for propagation of fish, industrial and agricultural uses and other uses requiring water of lesser quality) and that portion below that point to the junction of the Ashley and Cooper Rivers is classified as Class SC (waters suitable for crabbing, commercial fishing and any other usages except bathing or other shellfishing for market purposes, also for uses requiring water of lesser quality) (Reference 9). These restrictions are based on bacterial concentrations, the source of which is thought to be drainage from storm sewers, surface runoff not collected in storm sewers, septic tanks, malfunctioning treatment plants, point sources of untreated human wastes, and domestic livestock wastes.

2.09.2.1 All domestic sewage discharged into the lower Cooper River is now subjected to primary treatment and chlorination. Approximately 10 percent of the sanitary wastes from North Charleston and practically all of such wastes from the community of Mt. Pleasant receive secondary treatment. Sanitary wastes from Charleston are discharged after primary treatment into the mouth of the Ashley River. A list of discharge sources, their approximate daily discharges, and type treatment are presented in Table 8.

2.09.2.2 The West Virginia Pulp and Paper Company has by far the largest volume of industrial discharge into the Cooper River. These wastes are now subjected to primary treatment before being discharged into the river about 5 miles above Charleston, and are scheduled to be subjected to secondary treatment by late 1975. United Piece Dye Works discharges approximately 3.0 million gallons daily of untreated wastes

into Goose Creek which empties into the Cooper River about 6 miles above Charleston. Facilities to convey this waste to the North Charleston Municipal sewage treatment plant are now under construction. All other industrial effluents, with the exception of cooling water,receive at least primary treatment.

2.09.2.3 The South Carolina Public Service Authority operates four steam generating units below the Pinopolis Dam having a capacity of 412,000 kw. Cooling water is obtained from and returned to the tailrace canal. The volume of flow in the tailrace canal is sufficient to prevent a violation of state standards relating to thermal pollution.

2.09.2.4 One of the major industrial developments along the Cooper River is the Bushy Park Industrial Area which consists of land set aside for industrial development between the Back and Cooper Rivers. The development includes a dam across Back River which forms a reservoir and a diversion canal from the West Branch of the Cooper River into the Back River Reservoir. Bushy Park was originally a joint venture of Charleston and Berkeley Counties and the City of Charleston to attract industries to the Charleston area. The City of Charleston now owns about 80 acres and the remainder (about 4,300 acres) is distributed among the following industries: S. C. Electric and Gas Company operates steam generating facilities, Verona Corporation operates a chemical plant, General Dynamics operates a plant which makes liquid natural gas tanks, Du Pont is building a "Dacron" polyester plant, and Moore-McCormick has acquired land but has not begun construction. There are no vacant sites remaining at Bushy Park.

2.09.2.5 The effluent from industries at Bushy Park is discharged into the Cooper River after treatment, which is considered adequate to prevent degradation of water quality in the river. S. C. Electric and Gas uses a 105 foot square oxidation pond for treating sanitary wastes of about 50 employees. Retention time in the pond is about 30 days and the effluent is discharged with the cooling water into the Cooper River. The volume of cooling water is about 463 mgd and under conditions of the state permit must not raise the ambient water temperature more than 4 degrees Fahrenheit during the fall, winter, or spring and 1.5 degrees Fahrenheit during the summer months. The Verona Corporation has a permit to discharge up to 25 mgd, but recent actual measurement by the S. C. Pollution Control Authority showed a discharge of about 2.6 to 3.5 mgd. Treatment facilities include an equalization and neutralization chamber, two aeration ponds, and two stabilization and settling ponds. General Dynamics has a state permit to discharge up to 15,000 gallons per day. Waste treatment includes passage through a mixed activated sludge package treatment facility and chlorination. The Du Pont plant is not completed but their sanitary permit allows

a discharge of 2,000 gallons per day. This effluent will be treated in an extended aeration package treatment plant and chlorinated.

2.09.2.6 The most recent comprehensive water quality studies on the Cooper River were conducted by the U. S. Environmental Protection Agency during October and November, 1971. These studies were published in April 1974 by the South Carolina Water Resources Commission as part of the Cooper River Environmental Study (Reference 10). The main objective of the study was to develop some capability for predicting changes which might result from rediversion of the Cooper River. To accomplish this objective, the EPA collected samples during periods when the daily discharge to the Cooper River from Lake Moultrie averaged 20,550 cfs (October 1971) and about 3,000 cfs (November 1971). A discussion of the pertinent data contained in this EPA report is presented in the following paragraphs. The stations referred to in the following paragraphs are shown in Figure 18. A summary of all physical, chemical, and microbiological data collected at each station during the two sampling periods is presented in Table 9.

a. Temperatures. Average water temperature at the sampling sites ranged from 20.8 to 22.1°C during the October study and 17.2 to 18.3°C during the November study. Extremes in temperature were 20.0 to 23.5°C during October and 14.5 to 22.5°C during November.

b. pH. Average pH values at the EPA sampling sites ranged from 7.2 to 7.7 in October with extremes of 6.4 to 8.3 units. The extremes in November ranged from 6.3 to 8.5 units with average values of 7.3 to 7.7 units.

c. Dissolved oxygen. Dissolved oxygen (DO) concentration extremes in the reach studied ranged from 3.4 to 8.4 mg/1 during October and 5.0 to 8.9 mg/1 in November. Average DO concentrations ranged from 5.9 to 7.8 mg/1 in October and from 6.3 to 8.3 mg/1 during November. During October, both the minimum DO concentration and the lowest average concentrations were measured at the lower stations (1, 3, and 4). In November, the lowest DO concentration encountered (5.0 mg/1) occurred at Station 7 at the bottom. The following text table presents average DO saturation values at each of the river stations at high and low slack tide.

Average Surface and Bottom Values of Percent Saturation of Dissolved Oxygen

Station	October		November	
	HWS*	LWS**	HWS	LWS
1-Surface	70.9	75.9	70.5	72.5
1-Bottom	70.5	67.7	77.7	73.2
3-Surface	81.0	86.6	71.0	75.4
3-Bottom	68.5	69.8	68.3	73.9
4-Surface	82.6	88.6[1]	76.7	77.5
4-Bottom	79.0	84.7	73.0	73.5
5-Surface	87.6	89.8	80.0	79.6
5-Bottom	86.3	88.5	80.4	79.3
6-Surface	85.7	84.5[1]	80.3	80.5
6-Bottom	87.5	85.6[1]	79.6	80.5
7-Surface	84.3	90.9[1]	73.7	78.9
7-Bottom	84.3	89.8[1]	72.7	82.4
8-Surface	87.8	92.1[1]	89.4	91.0
8-Bottom	88.3	93.1[1]	89.9	90.6
9-Surface	82.8	--	75.6	76.5
9-Bottom	82.4	--	75.2	71.0

* High Slack Tide
** Low Slack Tide
1 Single determination

Percent DO saturation decreased downstream from Station 8 during both sampling periods. This reduction in the lower reaches of the river generally corresponded to an increase in dissolved solids and chlorides. There was no significant difference in DO saturation between surface and bottom samples in November, however, in October, a significant difference existed between Stations 3 and 4 at high slack tide and Stations 1, 3, and 4 at low slack tide. Again, this difference was primarily attributed to increased chloride concentrations occurring near the bottom of the water column.

d. Biochemical oxygen demand. The five-day biochemical oxygen demand (BOD_5) levels measured in both the October and November studies were low at each station (Table 9). In October, average BOD_5 levels ranged from 0.8 to 1.1 mg/l with the highest individual value (2.6 mg/l) occurring at Station 3. In November, BOD_5 concentrations ranged from 0.3 to 1.0 mg/l.

e. Chlorides. Chloride concentrations ranged from 7 to 13,400 mg/l during the October study period and 8 to 14,800 mg/l during the November study. An average chloride concentration of 8 mg/l is considered to be the background level entering the Cooper River from Lake Moultrie. In October, surface to bottom chloride ratios (S/B ratios) at high slack tide indicated that a well stratified condition existed in the lower reach of the river with ratios of 0.266, 0.193, and 0.171 at Stations 1, 3, and 4, respectively, as shown in the following table.

Surface To Bottom Chloride Ratios

	October		November	
Station	HWS*	LWS**	HWS	LWS
1	0.226	0.137	0.567	0.802
3	0.193	0.915	0.499	0.614
4	0.171	1.083	0.532	0.401
5	1.250	1.000	0.827	1.241
6	1.000	1.000	1.067	1.100
7	0.889	1.000	0.846	1.000
8	1.000	1.000	1.000	1.000
9	0.889	1.000	1.090	1.083

* High Slack Tide
** Low Slack Tide

At low slack tide, S/B ratios indicated that vertical stratification occurred only at Station 1 with average S/B ratios changing from 0.317 at Station 1 to 0.915 at Station 3. Maximum saltwater intrusion extended as far upstream as Station 4 at high slack tide and between Station 3 and 4 at maximum low tide.

In November, chloride concentration extremes ranged from 8 to 14,800 mg/l with average concentration ranging from 10 to 9,030 mg/l. An average background concentration of 10 mg/l was being discharged from Lake Moultrie during the sampling period. Surface to bottom chloride ratios at high slack tide were indicative of vertical stratification at Stations 1, 3, and 4 where average readings were 0.567, 0.499, and 0.532, respectively.

At Station 5, the S/B chloride ratio was 0.827 indicating a non-stratified condition. At high slack tide during the November study, salt water intruded upstream between Station 5 and Station 6. At low slack tide, S/B chloride ratios indicated a rather weak vertical stratification at Stations 1 and 3. An average S/B chloride ratio of 1.241 at Station 5 along with an average bottom chloride concentration of 29 mg/l indicated a well-mixed, essentially freshwater condition.

f. Residue. Total nonfilterable residue (total suspended solids) ranged from an average of 9 mg/l at Station 8 to an average 37 mg/l at Station 1 during October. In November, total suspended solids ranged from 6 mg/l at Station 8 to an average of 45 mg/l at Station 3. In both the October and November studies, the higher concentrations of total suspended matter were measured near the bottom in those areas affected by saltwater intrusion, tidal mixing, and industrial pollution.

Volatile suspended matter followed the same general pattern as the total suspended solids. Volatile solids ranged from an average concentration of 3 mg/l at Station 8 to 14 mg/l at Station 1 during October and from 2 mg/l at Station 8 to 12 mg/l at Station 1 during November. As with total suspended solids, the higher concentrations of volatile solids occurred near the bottom at the lower river stations.

g. Nitrogen. Total Kjeldahl nitrogen (TKN) concentrations were low throughout the study reach during both the October and November sampling periods. Extreme values ranged from 0.23 to 0.59 mg/l in October and from 0.12 to 1.00 mg/l in November. Ammonia nitrogen concentrations were low at all stations during both sampling periods. Concentrations ranged from 0.01 to 0.12 mg/l during October and from less than 0.01 to 0.08 mg/l during November. Nitrite-nitrate nitrogen concentrations ranged from less than 0.01 to 0.12 mg/l in October and 0.01 to 0.21 in November.

h. Phosphorus. Total phosphorus (as/P) concentrations were low at all stations during the October study period and varied from 0.02 to 0.08 mg/l. Average concentrations ranged from 0.03 to 0.05 mg/l. Orthophospate concentrations (as/P) ranged from less than 0.01 to 0.07 mg/l during the same period. The highest total and orthophosphate concentrations were measured at Station 1. During the November study period, total and orthophosphate concentrations were generally low at all stations. Total phosphate concentrations (as/P) ranged from 0.01 to 0.20 mg/l and orthophosphate concentrations (as-P) ranged from less than 0.01 to 0.10 mg/l.

i. Organic carbon. Total organic carbon (TOC) was found to be consistently low at all stations during the October sampling period. Concentration extremes ranged from 4.0 to 6.0

mg/l and average concentrations ranged from 4.2 to 5.2 mg/l. During the November study, TOC extremes ranged from 3.0 to 10.0 mg/l and average concentrations ranged from 4.6 to 7.7 mg/l. In general, average TOC concentrations measured in November were slightly higher than October.

j. Metals. Concentrations of copper, chrominum, lead, zinc, manganese, iron, and mercury were measured by the EPA at Stations 1, 6, 7, and 9 during the October and November study periods. As might be expected, the highest concentration of metals was found at the more saline station, Station 1. A summary of metals data is presented in Table 9.

k. Pesticides. Pesticide concentrations were measured by the EPA during the October study period only. Eighteen pesticides were analyzed from composite water samples collected at each station. The following table lists the individual pesticides and the minimum detection limit of the analytical procedure. No pesticide levels were detected above the detection limits used.

Pesticides Analyzed For and Minimum Dectection Limits

Pesticide	µg/1 Minimum Detection Limit
Aldrin	<0.005
Lindane	<0.002
Chlordane	<0.05
Chlorobenzilate	<0.5
DDD	<0.01
DDE	<0.01
DDT	<0.02
Dieldrin	<0.01
Endrin	<0.02
Heptachlor Epoxide	<0.01
Heptachlor	<0.005
Methoxychlor	<0.1
Toxaphene	<0.25
Diazinon	<0.2
Guthion	<0.5
Malathion	<0.2
Methyl Parathion	<0.02
Parathion	<0.04

1. Bacteria. Station 1 had the highest fecal coliform densities found during the October and November study period with counts of 830/100 ml and 460/100 ml, respectively. The lowest densities were found at Station 8 where the respective October and November counts were 26/100 ml and 30/100 ml. There was a general increase in densities downstream from Station 8 with a noticeable increase occurring in the vicinity of Stations 6 and 7. The higher levels at Station 7 were possibly caused by an adjacent housing development. Coliform densities also increased downstream of Station 4 most likely as a result of wastes entering the river from Goose Creek and from the municipal and industrial development downstream. During October, the mean surface coliform density at Station 1 was four times higher at high slack tide than it was at low slack tide. A similar observance was made during November except that densities were only about twice as high at high slack tide. These data suggest a possible upstream movement of wastes on an incoming tide.

2.09.3 Wando River. The water quality of the Wando River is generally good and according to the latest state classifications, it is classified as SB (Waters suitable for bathing and any other usages except shellfishing for market purposes. Suitable also for uses requiring water of lesser quality). The quality of waters in the Wando River system is being studied in detail by the South Carolina Water Resources Commission as part of the Wando River Environmental Quality Study. An interim report on this study was published in April 1973 (Reference 11). The summary and conclusions section of the water quality portion of the above report is presented below. Station locations are shown on Figure 19.

"1. Dissolved oxygen remained fairly high during the sampling period (January, 1973) ranging from a low of 7.7 mg/l to a high of 11.4 mg/l with most of the readings greater than ten. Dissolved oxygen saturation was above 85 percent most of the time. The lowest dissolved oxygen saturation reading during the sampling period was 60 percent and this was coincident with a water temperature of 4°C. The highest DO saturation was recorded as 100%. There is an apparent defect in the lower Wando River as measured by this criterion. Readings are progressively lower from the Cooper River (Station 1) upstream to the head of Hobcaw Creek at Station 4 where the lowest average DO saturation was experienced. Above Hobcaw Creek (Stations 5-8) DO saturation improved dramatically. Five-day Biological Oxygen Demand (BOD) readings ranged from 1.25 mg/l to 5.2 mg/l with an average of 2.68 mg/l. BOD readings were generally higher at the stations nearer the river mouth. In this study BOD was probably about normal considering the range of water temperatures which prevailed. While no rigid standards have been established for water quality based upon oxygen content alone, the net indication from arbitrary criteria for oxygen regimes is that a moderately high water quality exists in the Wando River as compared to other waters in the Charleston harbor environs.

2. Turbidity as measured by Secchi disk readings and by turbidimeter is generally low indicating a lack of suspended or colloidal material. Turbidity readings are somewhat higher at those sampling points nearer the harbor.

3. Fecal coliform bacteria were detected in such numbers as to substantiate assignment of "SB" classification to these waters. Some of the individual samples give rise to the belief that standards could be greatly exceeded at certain times of the year and under varying flow regimes. Station No. 4 located at the head of Hobcaw Creek gave consistently higher readings than did Station No. 3 located at the mouth of the tributary. Stations 1-4 produced generally higher counts than the upstream sampling points No.'s 5 through 8. The sources of human-waste pollution thus appear to be associated with Cooper River materials which ultimately enter the Wando and are transported upstream, and with materials that enter Hobcaw Creek presumably from the adjacent residential areas.

4. Heavy metals consisting of cadmium, chromium, copper, lead, and mercury were tested for and all except lead appeared singly or in combination in some of the samples. None of the samples were lead positive. No other metals were assayed.

Cadmium was detected in water samples on three of the sampling days but not at all stations simultaneously. Concentrations ranged as high as 45 ug/l which is within the range of some drinking waters (.04 ug/l to 60 ug/l) but exceeds the U. S. Public Health Service maximum allowable for interstate carriers (10 ug/l). Toxic levels of 200 ug/l are reported to be lethal to fish.

Chromium was detected on only one sampling day and at only one of the eight stations. This single reading was 543 ug/l which is about ten times the maximum U. S. Public Health Service standard for drinking water. The magnitude of this reading and the fact that only one of eighty samples was positive, casts some suspicion on the accuracy of the test or in recording findings. While no inference is drawn from this particular assay, it is not likely that chromium offers any health problems. In any future quality assessments, chromium detection processes should be conducted with especial care.

Mercury occurred in 74 of the 80 samples and ranged in concentration between 0.1 ug/l and 3.10 ug/l. These readings averaged 0.73 ug/l which exceeds the U. S. Public Health Service standard of 0.50 ug/l, or ½ part per billion.* The naturally occurring abundance and distribution of mercury in soils and waters accounts for a portion of the detected amounts of this element. For example, a recent study of mercury in soils over the nation (Shacklette, 1971) showed a geometric average of 96 parts per billion (ug/l) for the eastern United States.** Soils and sediments usually exhibit higher background concentrations than does water. This is the result of the affinity of mercury

* EPA states that their proposed level of 2.0 ug/l is the applicable standard. The average of readings in the Wando River would then be about 1/3 of the standard.

** EPA thinks this figure may be too high.

for muds and soil material together with the otherwise general insolubility of mercurial compounds. In addition, natural sea water contains .3 ug/l of mercury.*** (H & M, 1959).**** The presence of mercury does not necessarily imply a point source of pollution.

It is concluded from the results of aqueous sample testing that no critical levels of "heavy" metals occur and that no concern for public health is expressed.

It should be noted that sea water not only contains measurable quantities of the elements discussed as well as others, but that traces of some of these elements are essential to cell growth in some of the plants and animals that are a part of the local ecosystem."

2.09.4 Ashley River. The Ashley River is somewhat turbid and its banks are highly urbanized. According to the latest state classifications, the Ashley River is Class SC and as such is not suitable for swimming or the harvesting of oysters for market purposes. Although no recent data are known to be available concerning quality of Ashley River waters, it is believed that considerable improvement in water quality has recently been achieved as a result of newly constructed waste treatment facilities. Prominent among these are the two secondary sewage treatment facilities operated by the St. Andrews Public Service District which handle most of the wastes from the urban area adjacent to the Ashley River. In addition, all sewage discharged into the mouth of the Ashley River from the City of Charleston received primary treatment and chlorination. Current discharge sources along the Ashley River, their approximate daily discharge and type of treatment are presented in Table 10.

2.10 Air Quality. The Charleston County Health Department monitors air quality in the project area. Air quality varies with industrial development, the volume of automobile traffic, and local air circulation patterns. These factors interact in such a way that the highest suspended particulate content is found over parts of peninsular Charleston. The average suspended particulates measured during the period July through September 1973 at a station on the corner of Calhoun Street and Lockwood Drive ranged from 29.48 to 37.66 ug/m^3. Another peninsular station is located on the Queen Street Fire Station, where the geometric mean level of suspended particulates was reported to be 48.1 ug/m^3 during the period November 1972 to March 1973. These levels are well within the Federal standard which is 75 ug/m^3 and the State standard which is 60 ug/m^3.

*** EPA suggests that 0.05 ug/l is a more accurage figure for normal concentration of mercury in sea water.
**** Should read (HEM, 1959).

2.11 Climate. The prevailing winds are southerly in the spring and summer and northerly during the fall and winter. The proximity of the ocean has a tempering effect on Charleston's climate. In winter, the minimum city temperature may register from 10 to 15 degrees higher than that recorded at the airport located 10 miles inland; this marine influence may also cause the city's maximum temperatures to be lowered several degrees.

2.11.1 The winter months, December through February, are mild with rainfall averaging 18 percent of the annual total; spring rainfall from March through May averages about 20 percent of the annual total. A temperature of 20 degrees or less is seldom experienced. Some chance of snow flurries may occur in January, but a significant amount is rarely measured.

2.11.2 The summers are warm and humid; however, the temperature seldom reaches 100 degrees. Forty-one percent of the annual rainfall occurs in summer, mostly from scattered thunderstorms. The weather is moderate and sunny from late September to early November. The coastal area is subject to hurricanes during the summer and fall, with hurricane visitation occurring most often in August. The highest recorded hurricane surge tide was 11.2 feet above mean low water during the August 1893 hurricane.

2.11.3 The information below was compiled by the National Weather Station at the Charleston Municipal Airport, Charleston, South Carolina, and published by the Environmental Data Service, National Oceanic and Atmospheric Administration, U. S. Department of Commerce.

METEOROLOGICAL DATA FOR PERIOD OF RECORD

TIME	NORMAL DAILY TEMPERATURE F.°		NORMAL TOTAL PRECIPITATION (INCHES)	PREVAILING DIRECTION OF WINDS	HEAVY FOG DAYS
	MAXIMUM	MINIMUM			
No. of Years	29	29	29	14	20
January.....	61.2	38.3	2.54	SW	4
February....	62.5	40.4	3.29	NNE	2
March.....	68.0	45.4	3.93	SSW	2
April.....	76.9	52.7	2.88	SSW	2
May.....	83.9	61.8	3.61	S	2
June.....	89.2	69.1	4.98	S	2
July.....	89.2	72.0	7.71	SW	1
August.....	88.8	70.5	6.61	SW	1
September...	84.9	66.2	5.83	NNE	2
October.....	77.2	55.1	2.84	NNE	3
November....	67.9	43.9	2.09	N	4
December....	61.3	38.6	2.85	NNE	3
Year.....	75.9	54.5	49.16	NNE	28

2.12 Biological Resources.

2.12.1 Plants. In 1971, the Marine Resources Division of the South Carolina Wildlife and Marine Resources Department prepared an inventory and evaluation of wetlands to determine the quantity and quality of tidal marshlands within the Charleston Harbor estuary. This study was conducted under a contract with the U. S. Army Corps of Engineers as part of an estuarine values study and was published in December, 1972 (Reference 12). The final report is available for public review in the Charleston District office. A discussion of the pertinent aspects of this report is presented in the following paragraphs.

2.12.1.01 The Charleston estuary historically has been recognized for its value to fish and wildlife resources. The productive role of lands in this area has been profoundly illustrated and stressed by Lunz (Reference 13 and 14). The vegetation of the marshlands complex in Charleston Harbor is varied and it is now recognized that the types of vegetation present play a key role in the processes of biological productivity. Research by Odum (Reference 15) has shown that salt marsh grasses, by converting inorganic nutrients and sunlight into plant tissue, act as energy transfer mechanisms to consumer organisms in the estuarine system. Field observations and experimental trawling operations in the harbor system have clearly shown that tremendous quantities of dead marsh vegetation are transported to adjacent estuarine waters during the winter and early spring at times of extremely high tides. Teal (Reference 10) has calculated that approximately 45 percent of the total plant material is transported out of Georgia salt marshes into the estuary. This is also true in the Charleston area where the tidal range is large. Dead grass may become waterlogged and sink to the bottom or may be physically as well as biologically disintegrated into particulate organic detritus, becoming food for various invertebrates. These organisms are in turn eaten by small fish which are subsequently consumed by larger predators, etc. Thus, the link between fish and marsh is evident according to Teal (Reference 16). It is estimated that only about 7 percent of the marsh grass is eaten by insects, with the remainder being consumed by detritus feeding organisms such as amphipods, isopods and decapod crustaceans (shrimp and crabs), and fishes.

2.12.1.02 The importance of marshlands to estuarine productivity is not limited to the detritus they produce. Applying Teal's work (Reference 16) to comparable spartina marsh in the harbor, we postulate that algae may account for up to one-fourth of the organic material produced in a salt marsh. In fact, it has been shown by Pomeroy (Reference 18) that net algae production is constant throughout the year.

2.12.1.03 Productive salt marshes of Charleston Harbor are dominated by smooth cordgrass which occurs as tall, intermediate and short forms, depending on elevation. Tall cordgrass grows vigorously in areas below an elevation of 1.59 m. (5.2 feet) msl in Charleston Harbor and is the most productive of the three types. Odum (Reference 15) reported that smooth cordgrass produces approximately 2,000 g/m^2 or 10 tons per acre (dry weight) in Georgia marshes; this figure is applied to the entire crop of this species in Georgia. While there is evidence to infer that Georgia marshes do not average 10 tons per acre (actually 2,240 g/m^2) as reviewed by Wass and Wright (Reference 19), there are data indicating that smooth cordgrass averages more than 4.4 tons per acre (985 g/m^2) in North Carolina saltmarsh (Reference 20). These data suggest that annual production in South Carolina saltmarshes would range between 2.9 and 4.4 tons per acre at a minimum. Charleston Harbor marshes would probably be somewhat higher in production than the State's average since the cordgrass so prevalent in this area appears to be extremely vigorous in certain areas. Nutrients from sewage pollution in years past may have been beneficial in stimulating growth even though the water quality was degraded. Marshall (Reference 21) showed that cordgrass marsh receiving sewage plant effluent produced more biomass, reached its peak biomass sooner and was apparently not injured by fertilization.

2.12.1.04 Black needlerush is also commonly found in Charleston Harbor marshlands. It is generally considered the least important of the common marsh plants (Reference 22) and is usually associated with higher fringe areas above the mean high water line. However, during this survey black needlerush was found in mixed stands with smooth cordgrass in upstream locations of transition from salt to brackish and fresh water.

2.12.1.05 In the upper Cooper River near Goose Creek and upstream to the "Tee", the marsh vegetation gradually changes to a brackish and freshwater type. Brackish water marshes in the Charleston Harbor study area occupy a transitional zone area between true salt marsh and fresh water marshes. These marshes are prevalent in the upper Cooper from the area of its confluence with Yellow House Creek to the vicinity of Bushy Park and Moreland Landing. While many of the salt marsh species still occur in this area, there is a trend toward greater diversity including such species as bulrushes, cattail, giant cordgrass, etc.

2.12.1.06 Plant zonation in the lower harbor is more subtle and difficult to define where unconsolidated stands of smooth cordgrass are found. Generally, there are four zones that can be delineated from the water's edge to the woodland: (1) the "edge marsh" or tall smooth cordgrass zone; (2) the "low meadow" or medium smooth cordgrass; (3) the "saltgrass meadow" or stunted smooth cordgrass - salt grass, salt meadow cordgrass zone; and (4) the "high meadow" or salt meadow cordgrass - black needlerush - glasswort - sea ox-eye zone.

2.12.1.07 The different plant zones in the Charleston Harbor area area are assigned to a single priority based on overall value to marine resources. These priorities are as follows:

Priority I. To include areas of highest value to fisheries and wildlife resources; consisting primarily of regularly flooded, high salinity marshes. Regularly flooded, brackish marsh could be included dependent on location. Vigorous smooth cordgrass (medium and tall growth) as described in vegetative zones (1) and (2) above is the dominant vegetative type.

Priority II. To include areas of second highest value to fisheries and wildlife resources; consisting primarily of regularly flooded salt and brackish marsh. Regularly flooded fresh marsh could also be included. Smooth cordgrass (medium growth) as described in vegetative zone (2), is the dominant vegetative type. Regularly flooded black needle rush, giant cordgrass and related brackish and fresh types are included dependent on location.

Priority III. To include areas of third highest value to fisheries and wildlife resources; consisting of irregularly flooded salt, brackish and fresh marsh, flats and barren zones. Black needlerush, salt meadow cordgrass, sea ox-eye, salt grass, glasswort, and stunted smooth cordgrass are generally found in vegetative zones (3) and (4). Areas within this priority are classified as realistic for management.

Priority IV. To include areas of little value to fisheries and wildlife resources; consisting of irregularly flooded salt and brackish marsh, flats, barren zones and areas significantly altered by development. These areas are not classified since they have very little potential for management. Outer margins of diked disposal areas, undiked disposal areas and areas fouled by industrial or other wastes are characteristic of this type.

2.12.1.08 The S. C. Wildlife and Marine Resources Department has assigned the following priorities to the marsh areas along the river systems (Wando, Cooper, Ashley) of Charleston Harbor. The following text table presents a component breakdown of the marsh types in Charleston Harbor.

MARSHLAND ACREAGE BREAKDOWN

Priority Classification, Charleston Estuary Marsh (Acres)

Subsystem	Priority I	Priority II	Priority III	Priority IV
Wando River	9,871	976	0	0
Harbor	3,148	2,066	116	0
Stono River	0	808	0	0
Ashley River	2,760	1,527	568	0
Cooper River	0	9,172	30	1,641
Total	15,779	14,549	714	1,641

2.12.1.09 The Cooper River System (Figure 21 and 22) has 9,172 acres of Priority II march, 30 acres of Priority III marsh and 1,641 acres of Priority IV marsh. There are no Priority I marshes within this system.

2.12.1.10 The Wando River System (Figure 23) has 5,471 acres of Priority I marsh and 976 acres of Priority II marsh. There are no Priority III or IV marshes within this system.

2.12.1.11 The Ashley River System (Figure 24) has 2,760 acres of Priority I marsh, 1,527 acres of Priority II marsh, 568 acres of Priority III marsh and no Priority IV marsh.

2.12.1.12 Charleston Harbor (Figure 25) contains 3,148 acres of Priority I marsh 2,066 acres of Priority II marsh, 116 acres of Priority III marsh and no Priority IV marsh.

2.12.1.13 Other abundant plant species in the Charleston Harbor area include but are not limited to wax myrtle, sea-myrtle, marsh elder, cabbage palmetto, pokeweed, sedge, stiff fimbristylis, crab grass, eastern red cedar, loblolly pine, sweetgum, southern magnolia, black gum, red bay, black cherry, water oak, live oak, sandspurs, bermuda grass, greenbriar, soft-stem bulrush, southern wild rice, alligatorweed, narrow-leaved cattail, chinese tallow-tree, pennywort, spike-rush, smartweed, salt-cedar, aster, coco, and marsh mallow.

2.12.2 Wildlife. With its great natural resources and variety of habitat types which include marshes, high lands, swamps, and fresh and salt waters, Charleston Harbor and surrounding areas abound with a wide variety of wildlife species. Not only are there a large number of resident species, but there are many seasonal visitors which breed, overwinter and/or pass through this section of the U. S.

2.12.2.1 Birds. There are a great number of resident and seasonal birds within the Charleston Harbor area. Many water-fowl species may be seen during various times of the year including the mallard, black duck, pintail, American widgeon, blue-winged teal, green-winged teal, wood duck, redhead, canvasback, ring-necked duck, greater and lesser scaup, common goldeneye, buffle-head, ruddy duck, American coot, common gallinule, and purple gallinule.

2.12.2.1.1 Other species associated with freshwater or brack-ish habitats include the common egret, snowy egret, cattle egret, belted kingfisher, marsh hawk, double-crested cormorant, common loon, pied-billed grebe, great blue heron, Louisiana heron, little blue heron, green heron, black and yellow-crowned night herons, American bittern, least bittern, glossy ibis, white ibis, Virginia rail, sora

rail, king rail, clapper rail, long and short-billed wren, red-winged blackbird, boat-tailed grackle, common snipe, the eastern brown pelican and osprey.

2.12.2.1.2 Shorebirds and gulls found in the area at various times of the year include the American oystercatcher, semipalmated plover, Wilson's plover, willet, dunlin, short-billed dowitcher, sandpipers, black-necked stilt, herring gull, laughing gull, ring-billed gull, royal tern, and killdeer.

2.12.2.1.3 Upland species include the turkey vulture, black vulture, sharp-shinned hawk, red-tailed hawk, red-shouldered hawk, osprey, sparrow hawk, turkey, bobwhite, American woodcock, rock dove, mourning dove, ground dove, yellow and black-billed cuckoo, screech owl, great horned owl, short-eared owl, barn owl, barred owl, chuck-will's-widow, whip-poor-will, common nighthawk, common flicker, pileated woodpecker, red-bellied woodpecker, yellow-bellied woodpecker, hairy woodpecker, downy woodpecker, eastern kingbird, tree swallow, purple martin, blue jay, common and fish crow, robin, mockingbird, tufted titmouse, and other dickeys.

2.12.2.2 Mammals. Although the immediate Charleston Harbor area offers only limited habitat for most mammal species due to extensive development, suitable habitat is available in the marshes and uplands associated with the numerous tidal creeks and rivers which enter the harbor. Mammals commonly associated with these areas include the opossum, various shrews, eastern mole, various bats, raccoon, long-tailed weasel, mink, river otter, striped skunk, gray fox, bobcat, eastern gray and fox squirrels, southern flying squirrel, numerous mice and rats, eastern cottontail rabbit, marsh rabbit, white-tail deer, and feral pig. The only marine mammal commonly observed in the harbor is the Atlantic bottle-nosed dolphin.

2.12.2.3 Reptiles and Amphibians. The most common marine reptile in the area is the diamondback terrapin. Other turtles that occur in the harbor and offshore waters include the Atlantic loggerhead and the Atlantic green turtle.

2.12.2.3.1 Within the three river systems and in the harbor itself, there are a great number and variety of reptiles and amphibians. Animals commonly found in the freshwater aquatic habitats are the alligator, common snapping turtle, spotted turtle, eastern mud turtle, chicken turtle, Florida and spiny soft-shell turtle, black swamp snake, banded water snake, brown water snake, eastern cottonmouth, lesser and greater siren, leopard frog, and bull frog.

2.12.2.3.2 In the drier upland habitats are found the garter snake, eastern hognose snake, southern ring-necked snake, black racer, eastern coachwhip, rough green snake, yellow rat snake,

scarlet snake, scarlet king snake, eastern king snake, southern copperhead, pigmy rattlesnake, canebrake rattlesnake, eastern diamondback rattlesnake, southern toad, spring peeper, green tree-frog, and cricket frog.

2.12.2.4 Rare and endangered species. There are 10 endangered species, 1 peripheral species and 3 status undetermined species which occur or possibly occur in the Charleston Harbor area (Reference 23).

2.12.2.4.1 Endangered species. Endangered species can be defined as those species in danger of extinction throughout all or a significant portion of their range. Their peril may result from one or more causes--loss of habitat or change in habitat, overexploitation, predation, competition of disease.

Endangered species [1/] are:

Fish	
Shortnose sturgeon	Acipenser brevirostrum
Reptiles and amphibians	
American alligator	Alligator mississipiensis
Birds	
Eastern brown pelican	Pelecanus occidentalis carolinensis
Southern bald eagle	Haliaeetus l. leucocephalus
Peregrine falcon	Falco peregrinus
Bachman's wabler	Vermivora bachmanii
Kirtland's warbler	Dendroica kirtlandii
Eskimo curlew	Numemius borealis
Red-cockaded woodpecker	Dendrocopus borealis

The shortnose sturgeon was a resident of Atlantic seaboard rivers from New Brunswick to Florida, however, most recent records are from the Hudson River. The alligator is commonly observed in freshwater rivers and lakes. The brown pelican is a commonly observed resident of coastal South Carolina. The bald eagle is a permanent resident of the state and although individual birds are occasionally seen in the vicinty of Charleston, they are not common. The peregrine falcon, Kirtland's warbler and the Eskimo curlew are transient species. According to the U. S. Fish and Wildlife Service, Bachman's warbler, one of the rarest of our small birds, has been observed in the I'on Swamp. The red-cockaded woodpecker is a resident of old-age pine woodlands.

1/ These species also appear on the Department of Interior's "List of Endangered Fauna", May, 1974.

2.12.2.4.2 Peripheral species. A peripheral species--"is one whose occurrence in the United States is at the edge of its natural range and which is threatened with extinction within the United States although not in its range as a whole." The only peripheral species known to occur in the project are is the roseate spoonbill (Ajaia ajaja) which is a transient.

2.12.2.4.3 Status undetermined species. A status undetermined species--"is one that has been suggested as possibly being rare or endangered, but about which there is not enough information to determine its status." The following species are in this category:

American osprey	Pandion haliaetus carolinensis
Wood ibis	Mycteris americana
Eastern pigeon hawk	Falco c. columbarius

The osprey and wood ibis are locally common in the area.

2.12.3 Fish. The vast complex of salt and freshwater marshes, sounds, tidal creeks, and rivers in the project area provides excellent habitat for a diverse array of marine and freshwater fish species.

2.12.3.1 Cooper River. The principal freshwater sport fishing areas are located in the Cooper River and contiguous waters. The Cooper River is characteristic of a large river because of the large volume of water released from Pinopolis dam for power generation. Peak discharges frequently inundate about 7,300 acres of marshes and abandoned rice fields. The inundation of these low-lying areas provides habitat for small fishes and invertebrates which contribute a significant amount to the overall productivity of the Cooper River. This high productivity is reflected somewhat in the large number of fish species (73) collected from the river during a recent study.

2.12.3.1.1 The Cooper River annually receives runs of anadromous fish with large numbers of striped bass, blueback herring, and American and hickory shad ascending the river to spawn, mainly in the West Branch between the "Tee" and Pinopolis Dam. Just below the dam and adjacent to the tailrace canal, the South Carolina Wildlife and Marine Resources Department operates a striped bass hatchery. Fry produced at this hatchery come from eggs which are stripped from Cooper River striped bass captured in the tailrace canal.

2.12.3.1.2 The transition from a marine to a freshwater environment usually occurs in the general vicinity of the junction of Goose Creek and the Cooper River. The best freshwater fishing and the most heavily utilized areas are the East Branch of the Cooper River and the tailrace canal. The Back River Reservoir is

also heavily fished, partly because of convenience of access. Good fishing is also provided by the West Branch of the Cooper River between the "Tee" and the vicinity of Goose Creek.

2.12.3.1.3 Principal species appearing in the sport fisherman's catch on the freshwater portions of the Cooper River and contiguous waters are striped bass, largemouth bass, bluegill, black crappie, redbreast sunfish, redear sunfish, warmouth, spotted sunfish, channel catfish, chain pickerel and bullheads.

2.12.3.2 Charleston Harbor and contiguous waters. Recent studies on the value of Charleston Harbor to marine resources were conducted by the Marine Resources Center of the South Carolina Wildlife and Marine Resources Department in cooperation with the U. S. Army Corps of Engineers (Reference 12). The purpose of this study was to evaluate the adult and juvenile fish fauna in the system and to incorporate these findings into an overall assessment program for the coastal zone.

2.12.3.2.1 Research trawling for this study was conducted during 1970-1971 on a monthly basis and has provided pertinent data on various faunal elements which definitely establishes the Charleston Harbor area as an important nursery area. As might be expected, the trophic structure of the estuary varies from season to season with biological activity reaching a low point in the winter as many species become relatively inactive or migrate to offshore waters. In the spring, there is a rapid rise in ecosystem metabolism and productivity increases at all levels.

2.12.3.2.2 Sampling stations occupied during the study were located in the Ashley River and Beresford Creek and near Ft. Johnson and Hog Island. A summary of the species captured in the Charleston Harbor area and Morris Island area during this study are presented in Tables 11 and 12, respectively. A total of 70 species of fish were captured, many of which are valuable in the makeup of commercial and sport fisheries in the project area. As shown in the tables, some of the species captured are year-round residents and are found in all zones of the harbor while others are migrant forms that utilize the harbor as a nursery area and then move into offshore waters. The great diversity of species found during this study tends to document the fact that the Charleston Harbor area is a valuable asset to the area's marine resources.

2.12.3.2.3 The harbor and adjacent inshore and offshore waters support an intense sport fishery. Principal species caught in inshore waters by surf, pier, and small boat fishermen include but are not limited to red and black drum, sheepshead, northern kingfish, striped bass, bluefish, spotted seatrout,

spot, croaker, cobia, flounder, Florida pompano, toadfish, black sea bass, gafftopsail catfish, sea catfish, ladyfish, and Spanish mackerel.

2.12.3.2.4 In addition to the aforementioned inshore fishing, there are many charter boats, head boats and large private boats which fish the offshore waters for king and Spanish mackerel, bluefish, dolphin, white and blue marlin, sailfish, wahoo, cobia, crevalle jack, barracuda, little tunny, skipjack tuna, amberjack, black sea bass, groupers, red and vermillion snapper, red porgy and triggerfish.

2.12.3.3 Ashley River. The Ashley River contains the common freshwater and marine forms found in other coastal streams of this area, although studies reported on in 1964 (Reference 24) indicate that biological productivity in the river appears to be lower than that of other coastal streams. This condition was attributed to domestic and industrial pollution, which occasionally became severe enough to cause fish kills. However, significant improvement in water quality of the Ashley River has occurred since this report was written as a result of improved waste treatment practices. Although biological studies of the scope of those conducted in 1964 have not been conducted recently, local reports indicate that fish kills no longer occur and fisherman use and success have been increasing as a result of improved water quality. The Ashley River also serves as a nursery for blue crabs, brown and white shrimp, and various marine finfish.

2.12.3.4 Wando River. The Wando River generally contains the same fresh and saltwater fishes found in other coastal streams. Most sport fishing is by small boat for spotted seatrout, red drum, flounder, striped bass, and spot. Sports fishermen also take blue crabs and castnetters take a few shrimp.

2.12.3.4.1 The river is classified in the SB category which permits bathing, fishing, crabbing and other uses but prohibits the taking of oysters and clams except for transplanting to other waters from which they can ultimately be gathered. Recent information indicates that sub-tidal seed oysters occupy about 390 acres in the Wando River. Scattered concentrations of intertidal oysters also occur in the river. Commercial fishing is limited to a small blue crab fishery.

2.12.3.4.2 The Wando River also serves as an important nursery for many marine forms which later contribute to area sport and commercial fisheries.

2.12.4 Commercial fisheries. Annual fishery landing statistics compiled by the National Marine Fisheries service in cooperation with the South Carolina Wildlife and Marine Resources

Department show that commercial fishing in the Charleston area is a multi-million dollar industry. Principal species landed include shrimp, oysters, blue crabs, clams, alewives, American eels, flounder, whiting, black sea bass, and spot. Other species marketed include bluefish, croaker, black drum, red drum, groupers, grunts, king mackerel, menhaden, mullet, pompano, porgy, gray seatrout, spotted seatrout, shad, sharks, sheepshead, red snapper, vermillion snapper, Spanish mackerel, sturgeon, and squid. Landing data for the period 1964 to 1973, which may include species captured in areas other than Charleston, are presented in Table 13.

2.12.4.1 Upstream of the harbor in the tailrace canal and in Lake Moultrie, there is a commercial fishery for herring. During the spring of 1973, a total of 363,600 pounds or 805,000 herring were harvested from the Cooper River between March 5 and April 18. This represents a decline in both fishing pressure and harvest when compared to 1972. The herring catch on Lake Moultrie totaled 63,340 pounds in 1973 (Reference 25).

2.12.5 Invertebrates. Macroinvertebrates commonly associated with the saltmarsh environment in the project area include a variety of crustaceans, mollusks, and polychaetous annelids. Benthic fauna in the offshore disposal area was found by the South Carolina Wildlife and Marine Resources Department to be impoverished with little diversity and very small numbers of individuals as compared to inshore areas.

2.12.5.1 Crustaceans found in the area include two species which are commonly observed during periods of low tide, the mud fiddler crab and sand fiddler crab. The mud fiddler crab lives primarily on the clayey or muddy intertidal flats among the roots of cord grass while the sand fiddler crab generally inhabits the sandier substrates in areas near the high tide line. Other small crabs which are common in the marsh are the Red-jointed fiddler crab, mud crab, flat mud crab, and wharf crab. The red-jointed fiddler crab is quite abundant in the brackish water marshes. The mud crab is found in areas containing heavy oyster growth or shell accumulation; the flat mud crab occurs on the muddier substrates in the lower portions of the marsh; and the wharf crab is found near the high tide line where it actively crawls about on wharves and stone jetties or rests in shallow burrows along the shores. Other crustaceans commonly found in and around the marsh at various times of the year are blue crabs, hermit crabs, brown and white shrimp, mantis shrimp, grass shrimp, isopods, amphipods, and barnacles.

2.12.5.2 The American oyster is the most common pelecypod mollusk found in the area's marshes and generally occurs in clumps or large beds in the small tidal creeks. The collecting of oysters for human consumption is prohibited in the harbor area because of bacterial levels which exceed state standards. These

beds do, however, provide seed oysters and habitat for many species of fishes and invertebrates. Oyster larvae as constituents of the plankton community also serve as food for larger fish and invertebrates. The Atlantic ribbed mussel and the hard shell clam are also found in the area. The ribbed mussel is generally found in sandy mud or attached to oyster shells while the hard shell clam is found on sandy or muddy bottoms, between the tides and in shallow water.

2.12.5.3 Gastropod mollusks commonly observed in marshes around the harbor include the common marsh periwinkle, eastern mud snail, and the salt marsh snail. The periwinkle is generally found on cordgrass in the higher regions of the marsh near sandy substrates while the mud snail occurs in low areas where the substrate is always wet and muddy. The salt marsh snail is usually found near the high tide line under windrowed plant debris.

2.12.5.4 Polychaete worms also inhabit the salt marsh, sometimes in large numbers, and are found on a wide variety of substrates.

2.12.5.5 Although much of the salt marsh in the project area provides suitable habitat for the numerous invertebrates mentioned above, suitable habitat is somewhat limited in the deeper portions of the estuary. Samples collected during September 1965, by the former FWPCA for the Charleston Harbor pollution study revealed that adverse conditions for benthic organisms existed in many of the deeper reaches of the harbor. As a result, population numbers were generally found to be low with polychaete worms being the most common group of animals collected. The lower reaches of the Ashley and Cooper Rivers were found to be highly polluted and lacked bottom associated organisms at mid-channel stations. Moderately polluted areas were found in the main harbor from the mouths of the Ashley, Cooper and Wando Rivers to near Ft. Sumter. The only benthic organisms collected in these reaches were polychaete worms. Seaward of Ft. Sumter, benthic environments were not found to be polluted to any great extent. Animals collected in this reach included polychaete worms, shrimp, and crabs.

2.12.5.6 Economically, the most important invertebrates found in the estuary are the brown and white shrimp and blue crabs. As shown in Table 13, the commercial shrimp landings in the Charleston area in 1973 amounted to over 4 million pounds valued at almost 4.5 million dollars. Blue crab landings for this same period amounted to over 2 million pounds valued at over 400,000 dollars.

2.12.5.7 Aside from direct economic values, all invertebrates in the estuary are available as food for other marine invertebrates and fishes at some stage in their life cycle. For example, two studies conducted in Florida showed that invertebrates constituted

the principal source of food for more than 94 percent of the fishes harvested in Florida's valuable sport and commercial fisheries (Reference 34 and 35). A similar condition probably exists in the Charleston Harbor area.

2.12.6 Zooplankton

2.12.6.1 Available information on species composition and abundance of plankton populations in the Charleston Harbor area is rather limited. One of the first studies of the abundance of these organisms in the harbor area was completed by Bears Bluff Laboratories, Inc. in 1964 under a contract with the U. S. Fish and Wildlife Service (Reference 24).

2.12.6.2 The Bears Bluff report gives the following account of plankton populations in the Ashley, Cooper, Wando and Santee Rivers:

"Information from Plankton studies indicates that all of the river systems studied are areas of abundance for many zooplankton forms, including larvae and postlarvae of commercial species of fish and shellfish. The Santee River system was found to have the greatest recruitment of fish larvae and postlarvae, chiefly spot, croaker, and menhaden, over the study period. Blue crab larvae were most plentiful in the Wando River. Penaeid shrimp postlarvae were not plentiful in any of the rivers surveyed during 1963-1964, and this was reflected in the very low commercial shrimp catch over this period. Although the Ashley River was not found to be a region of comparatively great abundance for the larval and postlarval forms of commercial species, this river nonetheless ranked high in the abundance of copepods, mysid shrimp, etc., indicating that it is an area of high zooplankton productivity. On the basis of total zooplankton productivity it appears that of the four river systems studied, the Wando and Santee rank highest, with the Ashley River second. The Cooper River was found to be an area of very low zooplankton production, both for commercial and non-commercial forms.

The biological studies of the four rivers, when compared with similar studies made by Bears Bluff Laboratories throughout South Carolina since 1953, points to the fact that each river system differs somewhat from the others, but none of the four here reported on is so greatly different in numbers, kinds, and conditions of marine ogranisms to make it outstanding or abnormal."

2.12.6.3 Tables 14, 15 and 16 are reproduced from the Bears Bluff report (except for table numbers) and present data on species captured and catch per unit of effort in the Cooper, Wando, and Ashley Rivers. Catch per unit of effort was figured as follows:

"In estimating the abundance of the various zooplankters collected during this survey 'catch per unit of effort' values were used. The number of any particular form or species collected per twenty minute tow was designated as its catch per unit of effort for that tow. The total number of zooplankters of a particular form collected during one month divided by the number of tows made in that month, would then give the average monthly catch per unit of effort for that form."

2.12.6.4 In a more recent study (1971) the National Marine Fisheries Service (Reference 26) determined standing crop and species composition of free-swimming aquatic macro-organisms in three tidal streams of the lower Cooper River system (Figure 25) during the spring, summer, and fall. A total of 45 species of fish and three species of crustaceans representing 28 families were collected during the three sampling periods (Table 17). A total of 35 species were collected in the fall, 33 in the summer, and 26 in the spring. The greatest number of individuals, however, was taken in the summer (502,523/acre) and spring (189,131/acre). The average in the fall sample was 122,164/acre. The average standing crop for the three surveys combined was 271,273 organisms/acre.

2.12.6.5 Of the 45 fish species collected during the three survey periods, 10 species accounted for 95 percent of the total catch and three of these species accounted for 75 percent of that total. Listed in decreasing order of abundance, the 10 most abundant species were Atlantic croaker, Atlantic mendaden, mummichog, bay anchovy, spot, freshwater goby, striped mullet, silver perch, tidewater silversides, and southern flounder.

2.12.6.6 Invertebrates collected included grass shrimp, white shrimp, and blue crabs. Numerically, the invertebrates were most abundant accounting for 89 percent of the total collections. Grass shrimp made up 95 percent of the invertebrate catch.

2.12.6.7 Mean biomass was also dominated by invertebrates as they made up 63 percent of the 249 pound/acre average. Grass shrimp accounted for 131 pounds/acre and blue crabs 19 pounds/acre. The dominant fish species was the American eel at 16 pounds/acre, followed by striped mullet (13.1 pounds/acre), croaker (12.9 pounds/acre) and menhaden (12.6 pounds/acre).

2.12.6.8 The authors of this study concluded that "the studies strongly emphasized the importance of tidal streams as nursery areas as 65 percent of all organisms collected were marine euryhaline species, and many of the predominant forms were represented almost entirely by larval, post-larval, and juvenile stages." They also stated that: "Unquestionably, the Cooper River upstream of Charleston, S. C. is a dynamic system supporting diverse populations of freshwater, marine, and anadromous fishes and invertebrates.

All of these species are either esteemed as game fishes, commercially valuable, or important as forage species.

In contrast, the tidal streams of the lower Cooper River system were considerably more productive than those of the Port Royal Sound estuarine system surveyed in 1970. Although a greater diversity of species (67) occurred in the Port Royal tidal streams, the standing crops of aquatic organisms were by far greater in the Cooper River study areas. An average of only 8,585 organisms, with a biomass of 60.7 pounds per acre was collected in the Port Royal study areas; the Cooper River tidal streams supported 32 times that number and four times that biomass of organisms."

2.12.7 Description of offshore disposal area. During the late fall of 1971 and winter of 1972, the Marine Resources Division of the South Carolina Wildlife and Marine Resources Department made five cruises to the offshore hopper dredge dumping grounds and adjacent areas to ascertain the biological productivity of these areas. This study was conducted under a contract with the U. S. Army, Corps of Engineers as part of an estuarine values study (Reference 12). The final report is available for public review in the Charleston District office. Pertinent aspects of the report are presented in the following paragraphs.

2.12.7.1 A total of 28 fish species (see Table 18) was collected during experimental trawling operations in the offshore dumping area. This list was checked against a comparable sample from a near shore area which was collected by the Bears Bluff Laboratories' survey during the 1960's. The comparison did not indicate any significant difference in species diversity and/or numbers of individuals.

2.12.7.2 A comparison of Table 18 with Table 12 which presents relative abundance data collected at Morris Island, indicates the inshore area just west and southwest of the dumping grounds is more productive. The South Carolina Wildlife and Marine Resources Department attributed this differential productivity to natural habitat types rather than any adverse effect(s) of dumping.

2.12.7.3 Bottom grab samples at transects in the offshore disposal area consisted primarily of fine sand, coarse sand and shell with very little or no mud. A general picture of bottom sediments in the approaches to Charleston Harbor is presented in Figure 26. Fathometer readings indicated negligible buildup of deposited dredged materials. The benthic fauna (see Table 19) were found to be impoverished with relatively little diversity and very small numbers of individuals, as compared to inshore typically estuarine areas. However, the South Carolina Wildlife and Marine Resources Department felt that this was a normal community for this type of

bottom and concluded that the direct effect of dumping on the benthic fauna appeared to be limited. Most mollusks probably could manipulate to the surface after shallow burial.

2.12.7.4 The open shelf habitat from the 60-foot (10 fathom) curve to 108 feet (18 fathoms) is characterized by a rough bottom with coral, limestone and vast invertebrate communities. Beyond 108 feet (18 fathoms), broken or live bottom areas are generally more scattered and out to 150-180 feet (25-30 fathoms), the shelf contour is relatively smooth and has a very gradual slope. The shelf edge habitat off Charleston is characterized by a wide variety of bottom types. The dominant feature of this area is the remains of an ancient reef which runs approximately parallel to the coastline at depths of 150-210 feet (25-35 fathoms). This is a rich area for fishing with tremendous growths of invertebrates, sponges and corals and will be avoided during disposal of dredged material.

2.12.7.5 Generally, the bottom area to the east and southeast of the dumping site out to the continental shelf has live bottom areas interspersed at various localities. These are characterized by outcrops of rock with attachments of sessile organisms, sponges, etc. and are populated by a variety of fish species. No dredged materials will be placed in these areas.

2.12.8 Description of diked disposal areas

2.12.8.1 Daniel Island. The Daniel Island disposal site is located between the Cooper and Wando Rivers just upstream of the Cooper River bridges (Figure 5). The island is mostly farmland with scattered woodlots on the uplands with a fringe of Priority IV, Priority II, and Priority I marsh on the west, north and east sides respectively. The diked disposal area on Daniel Island currently being utilized for deposition of materials removed during maintenance dredging is located on the southern end of the island. Due to the frequency of dredging, the interior of the disposal area is mostly recently deposited sediment and there is little vegetation. Wildlife use in the disposal area is limited to feeding herons, egrets, plovers, sandpipers, dunlin, willets, black-necked stilts, gulls, crows, various other bird species, and small mammals. Wildlife species found in other areas on the island include the above species, deer, squirrel, rabbits, turkey, quail, dove, various dickeys, waterfowl, and several species of reptiles and amphibians.

2.12.8.2 Morris Island. Morris Island is located at the mouth of the harbor on the southwest side (Figure 5). Except for a small area at the northeast end, it has been diked and is currently being used as a disposal area for materials being dredged from the anchorage basin. Vegetation in the disposal area is sparse and wildlife utilization is similar to that described for Daniel Island.

The undiked area on the northeast end of the island is composed of salt marsh, beach and upland areas which are utilized by small mammals, reptiles and amphibians, waterfowl, and wading and passerine bird species. There are no plans for diking this area and using it for disposal at the present time.

2.13.8.3 Drum Island. Drum Island is located just south of Daniel Island between Town Creek on the west and the Cooper River on the east. The Cooper River bridges pass over the Southern portion of the island (Figure 5). Most of the outer perimeter of the island has been diked forming a disposal area of approximately 300 acres which is being utilized for deposition of a portion of the shoal materials removed from lower Charleston Harbor during Federal, state, and local maintenance dredging. Vegetation in the disposal area is sparse and wildlife utilization is similar to that in the Daniel Island disposal area. A major heron rookery is located outside of the diked area on the north side of the island. This fifteen acre area is densely vegetated with sea-myrtle, salt cedar, mulberry, wax myrtle, cabbage palmetto, Spanish bayonet, cord grass and Juncus. This rookery is used primarily by American egret, snowy egret, Louisiana heron, little blue heron, black-crowned night heron, glossy ibis, white ibis, cattle egret, and yellow-crowned night heron. No dredged material will be placed in this rookery during maitenance dredging operations.

2.12.8.4 Clouter Creek. The Clouter Creek diked disposal area is located on the east side of the Cooper River between Mile 11 and Mile 15 (Figure 5). The perimeter of the disposal area is classed as Priority IV wetlands. Plant species found around the perimeter include smooth cord grass, big cord grass, black needle rush, cattails, sedges, bulrushes, silverling, tamarisk, hackberry, Chinese tallow tree, wax myrtle, rattlebox, Russian thistle, dog fennel, giant ragweed, goldenrod, loblolly pine and various clovers. Inside the dike, vegetative cover varies from none to dense. The southern half of the area is covered with recently deposited dredged materials and is sparsely vegetated. The northern portion is vegetated with grasses, Aster spp., Solidago spp., Russian thistle, baccharis, tamarisk, smooth cordgrass, Juncus spp., and cattail. Wildlife utilization of the disposal area is limited due to the general absence of suitable habitat. Wildlife species most likely to occur in the area are marsh hawk, clapper rail, killdeer, herons and egrets, sandpipers, plovers, various dickeys, marsh rabbit, raccoon and rodents.

2.12.8.5 Yellow House Creek. The Yellow House Creek disposal area is located just north of Clouter Creek at about Mile 19 (Figure 5). As is the case with Clouter Creek, lands outside the diked area are classed as Priority IV wetlands by the South Carolina Wildlife and Marine Resources Department. Vegetation in this area is similar to that found around the Clouter Creek disposal area. The area inside the dike is mainly vegetated with cattails, black needle rush, smooth cord grass, big cord grass, and widgeon grass. Wildlife utilizing the area inside the dike include sandpipers, killdeer, plovers, shovelers, little blue heron, great blue heron, Louisiana heron, snowy egret, common egret, black-necked stilt, gulls, coots, scaup, marsh hawk, clapper rail, raccoon, marsh rabbit, deer, mice, rats, and water snakes.

2.13 Economic development

2.13.1 Port of Charleston. The Port of Charleston is a major port and is vital to the economies of the State of South Carolina and the nation. Although the port primarily serves the State of South Carolina, many of the exports passing through are produced by firms located in North Carolina, Georgia, and Tennessee. In addition, many imports are utilized by firms in these states as well. The primary area in South Carolina (measured by value of products) utilizing the port is the Greenville-Spartanburg industrial area. Tables 20, 21, and 22 break down the involvement of counties throughout the State of South Carolina in important export trade through the port of Charleston. In 1972, the port handled over 7.4 million short tons of waterborne commerce, with over 3.3 million being export tonnage. Oceangoing vessels transported 96.3 percent (7,199,861 short tons) of the total commerce. The remaining 3.7 percent (276,774 short tons) reflects the commerce moved by barge traffic mainly over the Atlantic Intracoastal Waterway or between points within the harbor. During the 15-year period 1958-1972, oceangoing commerce increased at the compound rate of about 4¼ percent, while total waterborne commerce increased at a compound rate of about 3-5/8 percent per year. The growth in waterborne commerce through the port over the past several years reflects the rapid economic development of the South Atlantic Region and the State of South Carolina. Imports and coastwise receipts are greater than exports and coastwise shipments and this trend is expected to continue. Major bulk imports are petroleum (residual fuel oil), farm products, chemical products, and plywood and veneer. Major receipts are petroleum and related products. The major exports consist of farm products, pulp and paper products, and textile products.

2.13.2 Economic indicators

2.13.2.1 General. The standard indicators and others found to be related to the use of Charleston Harbor are keyed to the State of South Carolina and U. S. Department of Commerce, Bureau of Economic Analysis (BEA) Economic Areas Nos. 28, 29, 30,

and 31. These economic areas have been delineated by the BEA and the Economic Research Service (ERS), Department of Agriculture, who have made national and area economic projections to 2020 for the Water Resources Council. The projections dated September 1972 have been adopted as the current appraisal of the long-range national trends for planning purposes. These projections are designated as "OBERS Projections". Thirty-five of the forty-six South Carolina counties are included in BEA Economic Areas 28, 29, 30, and 31, which are considered as representative of the general cargo tributary area of the Port of Charleston. Various combinations of these areas would be representative of the various petroleum products tributary area. The discussions presented in the following paragraphs are keyed to BEA Areas 28, 29, 30 and 31.

2.13.2.2 Population. The 1970 population of the State of South Carolina was 2,590,516, an increase of 8.7 percent over its 1960 population and a decrease from the 12.5 percent increase registered during the 1950-1960 decade. BEA Economic Areas 28, 29, 30, and 31, with 1970 populations of 805,960, 610,800, 400,739, and 430,761, respectively, registered changes over their 1960 populations of 10.3, 10.7, -1.3, and 16.9 percent, respectively. Almost all of the population increase in the immediate project area can be attributed to the growth of the North Charleston - Hannahan, St. Andrews, James Island, and Mt. Pleasant areas. About 47.6 percent of the state's 1970 population resided in urban areas as compared with only 41.2 percent of the 1960 population.

2.13.2.3 Income. The total personal income of residents living in the State of South Carolina amounted to about $7,550 million in 1970 and averaged $2,908 per capita, or about 74 percent of the national average. This represents an increase of about 60 percent in real per capita income over 1960 as compared with about 35 percent for the nation as a whole. The per capita income of BEA Areas 28, 29, 30, and 31 generally parallels that of the state as a whole.

2.13.2.4 Employment

2.13.2.4.1 General Employment. The average annual employment in the state in 1970 totaled 1,036,800 with 5.0 percent of the labor force unemployed. About 340,000 persons or about 32.8 percent were employed in manufacturing activities, 66,200 or about 6.4 percent were employed in agriculture, 148,800 or about 14.3 percent were employed in government, 142,400 or 13.7 percent were employed in wholesale and retail trade, and the remainder were either self-employed or in contract construction, transportation, communication, utilities, finance, insurance, real estate, unpaid family workers, or domestics.

2.13.2.4.2 Port related employment. According to a study conducted by the University of South Carolina for the State Ports Authority, the port complex directly employed 5,066 workers in 1972. Military and civilian employment at Charleston Naval facilities was 29,979 in 1972 with a combined payroll of $309,842,521. In addition, a survey determined

that approximately 104,000 employers felt that the port was essential or of substantial importance to their firm's operation.

2.13.2.5 Industrial development. The types of industry within the State of South Carolina are many and varied. Industry has expanded greatly in recent years. Manufacturing accounted for about 33 percent of the employment in the state in 1970 and construction accounted for about five percent. The major industries are textiles, chemicals, and allied products, non-electrical machinery, food and kindred products, electrical equipment and supplies, stone, clay, glass, and paper and allied products. As an indication of the industrial development in the state, the "value added by manufacture" has increased by a factor of 2.5 in constant dollars during the period 1954 to 1967. This trend is expected to continue.

2.13.2.6 Agriculture. Agriculture plays an important role in the economy of the state. The value of crop production in 1969 was over $260 million. However, the number of farms has decreased from 86,000 in 1960 to 52,300 in 1970 and the land in farms has decreased from 10,000,000 acres in 1960 to 8,300,000 acres in 1970. To partially offset this decrease in the number of farms and total acreage in farm lands, the average size farm has increased from 116 acres in 1960 to 161 in 1970.

2.14 Transportation facilities. An excellent network of Interstate, U. S., State and local highways, railroads and airlines adequately connect the population centers of the state with the port at Charleston and with all metropolitan and other centers in the nation. The network of primary highways and railroads provides the essential link between the Port of Charleston and its inland customers. Interstate Route 26 connects the port with Columbia and the Piedmont Region, and is the most direct route for the greatest number of trucks. Other major highways include U. S. Route 52 to Florence and points north, U. S. Route 78 to Augusta and Atlanta, and U. S. Highway 17 to coastal destinations. The two major railroads, Southern and Seaboard Coast Line, offer long distance freight service to points in the Southeast and Midwest. The Southern offers service to Columbia and Spartanburg, thence, on separate routes to either Atlanta or Knoxville. The Seaboard Coast Line has a predominantly north-south route orientation.

2.15 Waterborne traffic. During 1972, a total of 1,234 dry cargo ships, 296 tankers, and 8,164 other craft having drafts greater than 18 feet entered Charleston Harbor. Shipyard River has about 0.4 large ship passages per day and 0.55 small ship passages per day. If ship passages during 1972 are averaged for a year, then on a typical day Charleston harbor would have 11 one way passages of large ships and 64 one way passages of smaller ships or tows. The large ships are confined to Charleston proper and the Cooper River; the small ships use all the tributaries of the harbor.

2.15.1 Traditionally, Charleston has been the base for minecraft and the Shipyard has serviced these small ships as well as escort vessel types. In the past two decades, Charleston

has been developed as a base for nuclear-powered submarines and has expanded the activity of both the Naval Shipyard and the Naval Base. The current changes in the naval shore establishment together with re-location of ships may further increase the role assigned to Charleston. The minesweepers are small maneuverable ships and their movement would be analogous to those of small commercial vessels. It is estimated that submarine passage of the port occurs no more than two times each week, which again is small compared to 10 daily commercial large ship movements. The movements of escorts and auxiliaries operating out of the Naval Base might average on the order of one or two movements per day. The total movements of large naval ships through the harbor, therefore, is estimated to be no more than two per day, or about 20% of the commercial traffic.

2.16 Archaeological and historical elements. Charleston is the site of one of the oldest permanent settlements in the United States and has many areas and structures of great significance in the history of the country which span the period between the Revolutionary War and the post Civil War and Reconstruction period. Prominent among these is Fort Sumter which was the site of the first battle of the Civil War when it was fired upon by South Carolina troops from nearby Fort Johnson. Fort Sumter is a National Monument on a small man-made island in Charleston Harbor. Another old fort and also a National Monument is Fort Moultrie on the southwest end of Sullivans Island near the mouth of Charleston Harbor. The original palmetto fort was begun in 1776 and has been rebuilt several times. The grave of General Francis Marion, a Revolutionary War hero, is located near Pineville, just northwest of the project area. Boone Hall is an estate of about 738 acres just north of Charleston that was named for Major John Boone, who received the land as a grant in 1681 from the Lords Proprietors on behalf of the King of England. The mansion, gin-house, and slave houses have been restored and depict some aspects of local heritage and culture of the pre-Revolutionary era.

2.16.1 The latest editions of the National Register of Historic Places lists 59 sites in Charleston County and ten sites in Berkeley County. National Register Properties in Berkeley County are privately owned and are outside the project area. None of those located in Charleston County will be affected by the maintenance dredging of Charleston Harbor.

2.17 Recreation. With an average annual temperature of around 67 degrees, there are few days during the year when some form of outdoor recreation is not possible in the Charleston area. The primary recreational activities in the area include boating, both power and sail, and sport fishing. There are 25 small boat launching ramps, both fresh and salt water, and several yacht clubs within 20 miles of the city which are located within

minutes of prime fishing areas. There are also two fishing piers within 12 miles of the old city and more than 20 others within a two-hour drive. The beaches in the area are also excellent for surf fishing. Two public oyster grounds are within 12 miles of Charleston and both clams and oysters may be harvested in season. Other fishing is available on various deep sea fishing boats which offer daily trips to the Gulf Stream on an individual or charter basis. These boats operate from the Charleston Marina, the Fort Sumter Hotel dock and Shem Creek at Mt. Pleasant.

2.17.1 For the freshwater fisherman, the Santee-Cooper lakes and freshwater reaches of the Cooper River are less than one hour's drive from the city and provide fishing for striped bass, largemouth bass, crappie, bluegill, catfish, and other fresh water species.

2.17.2 Two state parks are located within an hour's drive of the city. Givhans Ferry, on the Edisto River, has excellent swimming and picnic areas and Edisto Beach Park, on the Atlantic Ocean, has a bath house, picnicking areas and rental cottages. Bulls Island and the Santee Romain Wildlife Refuge offer the opportunity to observe large colonies of birds and animals in their natural habitat. The Fish and Wildlife Service provides regular boat service to the island landing which is about 15 miles from Charleston. Emphasis is made of recreational opportunities offered by the Francis Marion National Forest.

2.17.3 The coastal plain is also noted for its wildlife and provides the hunter with an abundance of game species. The principal hunting areas are located on U. S. Forest Service (Francis Marion National Forest) and State owned or managed lands. There are also a number of privately-managed hunting areas where the public may hunt for a fee.

2.17.4 Other recreational opportunities available in the project area include seven golf courses, one of which is operated by the City of Charleston, four public swimming pools operated by the City of Charleston and three ocean beaches.

2.18 Future environmental setting without the project. Population centers are expected to expand to accommodate a growing population and new industries. This expansion will be achieved at the expense of undeveloped lands. The acreage devoted to cropland will continue to decrease as land of this type yields to the pressures of urban development or is planted in trees. The population in the project area in 1970 (OBE Economic Areas 28, 29, 30 and 31) was 2,248,300 or about 86.8 percent of the 2,590,516 population of the State of South Carolina. This represents a 9.3 percent increase in population over 1960 for the OBE Economic Areas and an 8.7 percent increase for the entire state as compared with a 14.3 percent increase for the United States. The state and area populations are both projected to increase at an average annual

rate of 1.3 percent over the next 60-year period. The labor force for the three OBE areas was about 42 percent of their total population in 1970, about the same as for the state. This ratio is expected to continue through 2030, the same as projected for the state. The annual growth rate of personal per capita income for the areas is expected to average 3.1 percent annually and increase from about 74 percent to 91 percent of the United States average per capita income during the next 60-year period. Because of the attractiveness of water-front developments, it is anticipated that considerable development will take place on the Cooper, Wando, and Ashley Rivers.

2.18.1 If maintenance dredging is discontinued, channels would eventually shoal up. This would create a situation where Naval facilities along the Cooper River would become inaccessible and shipping into and out of the Port of Charleston would decrease, adversely affecting local and regional economies. Local and regional growth and expansion would be greatly slowed and the future of the area would be questionable.

3.0 Relationship of the Proposed Action to Land Use Plans. The Berkeley-Charleston-Dorchester Regional Planning Council prepared a preliminary development plan for the three-county area to set forth major policies relating to desirable future development. In its present form, it is too non-specific to permit a determination of its relationship to the continued maintenance of channels in Charleston Harbor. There are no other land-use plans covering any area that would be affected by the proposed project.

4.0 The Probable Impact of the Proposed Action on the Environment.

4.01 The major effects of this and future dredging relate to effects on water quality and on the ecosystems within the harbor and disposal areas. Water quality is affected mainly by localized short-term increases in turbidity and sedimentation of adjacent water areas because of the bottom disturbance by the dredge cutterhead and the suspended and dissolved material in the effluent from the disposal areas. The effects on disposal areas include the smothering of plant and animal communities and the prevention of any substantial regrowth or colonization as long as the area continues to be used as a disposal area.

4.02 Water Ouality. An evaluation of data presented in Section 2 of this EIS indicates that continued maintenance dredging in Charleston Harbor will not create any long-term or large scale adverse impacts or detrimental effects on the water quality of the Charleston Harbor estuarine system.

4.02.1 It is characteristic of any hydraulic dredging project that water turbidity in the vicinity of the dredge will increase as a result of the mechanical action of the dredge cutterhead. Observations of earlier maintenance dredging in the harbor indicate there will be a temporary increase in turbidity in the area of dredging and, although visible at the surface only in the immediate vicinity of the cutterhead, the turbidity plume may extend several hundred feet either upstream or downstream as determined by tidal currents. Some increase in turbidities can also be expected adjacent to disposal areas, although construction of dikes and weirs should greatly reduce the sediment content of the effluent. The water turbidity in the offshore disposal area will also increase. The temporary and localized effects on resident biota of increased water turbidity are not considered to be of a magnitude to affect long-term productivity.

4.02.2 In addition to increasing turbidities, the disturbance of bottom sediments by the dredge may resuspend chemical substances, possibly increasing levels of nutrients, toxic substances, and B.O.D. Such effects would be most noticeable in the immediate vicinity of the dredge and would not extend any appreciable distance beyond the source. The disturbance of these sediments will not have any significant affect on the long-term productivity of the harbor ecosystem because of the low natural productivity of these fine sediments.

4.03 Biological Impacts. The major concern associated with dredging in Charleston Harbor relates to the effect of the removal of bottom materials and their subsequent discharge into open water or upland disposal areas on the existing ecosystem or man's use thereof. A discussion of the probable project effects on existing flora and fauna is presented in the following paragraphs.

4.03.1 Plants. Each use of a disposal area will normally result in the deposition of enough material to kill most vegetation growing therein. Most of the currently used disposal areas in the harbor are located on marshland that has been used enough that the soil elevation has been raised well above the highwater line. Such areas have been converted to uplands, and during the interval between their use as disposal areas, vegetative regrowth is characteristic

of areas above mean high water. Parts of other disposal areas have received so little use that they continue to support marsh vegetation. The loss of upland vegetation is considered to be a relatively short-term impact since native plants will gradually revegetate the area after dredging is completed. However, the loss of marsh represents a permanent loss since these marsh areas are converted to uplands. In view of the premium now placed on marshes, it is considered unlikely that any new disposal areas will be acquired by the project sponsor on marsh lands. Should the State of South Carolina acquire additional marshland for the disposal of material dredged from Charleston Harbor, this EIS will be revised accordingly and circulated for public review.

4.03.2 Birds. Birds will not be adversely affected to any extent by continued maintenance dredging. Species which utilize the diked disposal areas will probably be temporarily frightened away by construction noise and will temporarily stress populations in other areas as they compete for available food and roosting space. On the positive side, many species have been observed congregating around active disposal areas to feed on organisms in the dredged material.

4.03.3 Mammals. Although many species of mammals occur in the general vicinity, the only marine species which is common in the harbor proper is the bottlenose dolphin and it will not be adversely affected. A few small mammals inhabit vegetated areas in existing disposal areas and will be displaced as these areas are filled with dredged materials. Some mammals will also be displaced in upland areas selected for disposal when existing disposal sites are filled to capacity.

4.03.4 Reptiles. Marine reptiles in the project area, except for the diamondback terrapin, are mainly offshore forms which occasionally wander into lower Charleston Harbor or land forms which generally are not associated with the harbor proper. The diamondback terrapin is found in the vicinity of coastal marshes, tidal flats, or in general, any sheltered unpolluted body of salt or brackish water where it forages on fish, crustaceans, mollusks, and insects. Due to its habitat preferences, the terrapin will not be affected by the project. Some reptiles may also be displaced in disposal areas although numbers would be small.

4.03.5 Plankton. In 1972 the Belle W. Baruch Coastal Research Institute, under contract to the Corps of Engineers, studied the effects of Charleston Harbor sludge on photosynthesis, standing crop and growth of natural phytoplankton communities under laboratory and field conditions (Reference 27). The study was divided into two

sections: (1) the effects of dredged material on phytoplankton and (2) the effects of dredged material on certain invertebrate zooplankton.

4.03.5.1 Phytoplankton studies. Both laboratory and field studies were conducted for the phytoplankton studies.

4.03.5.1.1 Laboratory studies.

4.03.5.1.1.1 The first laboratory experiment was designed to test the direct effects of suspended sludge on primary productivity. Studies conducted with Charleston Harbor mud showed that as turbidities increased, primary production decreased which suggests that production in turbid waters is limited by low light intensities.

4.03.5.1.1.2 The second set of experiments was designed to determine whether toxic materials could leach out of resuspended sludge and influence phytoplankton growth. The results showed that the sludge extract enhanced the growth of Charleston Harbor phytoplankton.

4.03.5.1.2 Field studies.

4.03.5.1.2.1 For these studies, primary production was measured at three sites in Charleston Harbor during actual dredging operations. The three stations sampled were located: (1) north of Goose Creek; (2) south of Goose Creek; and (3) at the mouth of Shipyard River. At site 1 (salinity 0°/oo), primary production was greatest ½ mile upstream from the dredge, decreased at the dredge, and reached its lowest value 250 yards below and then increased ½ mile downstream. The results at site 2 were similar to those at site 1. At site 3, however, the highest production values and chlorophyll concentrations were found at the dredge site while stations above and below the dredge were not significantly different.

4.03.5.1.2.2 The researchers concluded that: "From the data it appears that the effect of dredging on the primary production of phytoplankton is initially inhibitory due to increased turbidity. Recovery, however, takes place downstream."

4.03.5.2 Zooplankton. Studies on the effects of dredging on the survival and physiology of zooplankton were divided into two phases.

4.03.5.2.1 In Phase I, sediment samples from different areas of Charleston Harbor were mixed with sea water; the particulate matter was allowed to settle to the bottom; and the supernatant was diluted to obtain 10, 25, and 50% concentration. The results of this study showed that the effects of the lower concentrations (10 and 25%) were minimal, but at the higher concentration, survival, metabolism, and behavior were all modified markedly. However, the only place a 50% concentration could possibly be encountered is in a disposal area.

4.03.5.2.2 Phase II was conducted during an actual dredging operation. For these experiments, water was collected from three regions in the harbor and at each region, water samples were taken at three sites: in the immediate vicinity of the dredge, 200 yards downstream, and from the disposal area. The results of these experiments showed that water from the disposal area was most toxic, followed by the water 200 yards downstream and finally by water from the dredge site.

4.03.5.3 From the above data, it would appear that although phytoplankton and zooplankton populations may be reduced somewhat during actual dredging operations, the area affected is comparatively small and dissipates rapidly with distance from the dredging operation. As a result, continued maintenance dredging is not expected to have any significant long-term effect on plankton populations.

4.03.6 Invertebrates.

4.03.6.1 Channels. As discussed in Section 1.0, dredging in the entrance channel will be accomplished by hopper dredge and that in the rest of the harbor will be accomplished by hydraulic pipeline dredge. In most dredging projects, benthic invertebrates in the path of the dredge cutterhead will be destroyed. This gross effect has been well documented in many studies and field investigations conducted along both the Atlantic and Gulf coasts (Reference 28, 29, and 30) and can be expected to occur to some extent during the proposed dredging. Many impact assessments have assumed that this destruction eliminates the relatively immobile members of the benthic invertebrate community in the dredged area for an extended period of time. However, recent research indicates that this may not be a valid assumption. For example, in a 1973 study of Altamaha Sound, Georgia, researchers at the Skidaway Institute of Oceanography (Reference 2) found that "...while the number of species, and especially the number of individuals per unit area were greatly reduced following dredging, several species were still present in some quantity. Recovery of the population to levels approaching those of the control stations appeared to be rapid. While this study suffers from lack of replication of sampling methods, it does provide an indication that the benthic community is able to quickly recover following dredging, and remains as a viable community both during and immediately after dredging operations are undertaken." The Skidaway Institute researchers hypothesized that rapid repopulation of benthic fauna in dredged areas may be due to: (1) suspension of many organisms in the water column with the turbulence created by the passing of the dredge, and subsequent resettling of some suspended organisms upon the dredged area, and (2) erosion or slumping of steep slopes of recently dredged channels, carrying benthic organisms into the channel in the process.

4.03.6.1.1 Evidence of rapid repopulation of dredged areas in the Charleston Harbor estuary was found during recent trawling by the South Carolina Wildlife and Marine Resources Department (MRD).

During their January 1974 trawl sampling at a station off the Columbus Street terminal, the trawl net retained several chunks of bottom sediments from an area reportedly "pre-maintenance" dredged (to a depth greater than -40 feet) less than one month prior to the sampling date. These benthic samples contained an abundance and diversity of worms (mostly polychaetes), mud crabs, and bivalve mollusks comparable to that of numerous preserved samples from various undredged areas later examined at MRD headquarters (Reference 2).

4.03.6.1.2 Although the above study indicates that some invertebrates occur in the deeper channalized areas of the harbor, the major concentrations are found in the shallower portions of the estuary in areas which are not affected to any significant degree by maintenance dredging.

4.03.6.2 Ocean disposal site. The proposed plan includes the use of an existing offshore dumping area for disposal of sediment removed from the entrance channel. Since Fiscal Year 1965, some 367,460 to 1,410,000 cubic yards of material have been dumped in this offshore area annually with little evidence that any buildup is occurring. To evaluate the impacts of this type of disposal, the Corps of Engineers, as part of the estuarine values study, contracted with the South Carolina Wildlife and Marine Resources Department to study the biological condition of the present offshore disposal area and to determine probable effects of continued use (Reference 12). As discussed in Section 2.0, these studies indicated that there was little diversity in benthic fauna in this offshore disposal area and very small numbers of individuals as compared to inshore typically estuarine areas. They concluded, however, that this was a normal community for this type of bottom and that the direct effect of dumping on benthic fauna appeared to be limited.

4.03.6.2.1 In addition, they found that: "This large area has been utilized for at least six years as a disposal site with no evidence of silt buildup or adverse ecological effects." They also stated that: "However, the possibility exists that the buildup of mud deposits on the bottom could result in the enhancement of adjacent areas by creating habitat for valuable species such as Penaeid shrimp. This in turn, would generate potential for increased or, at least, more productive commercial fisheries. It is felt that the existing hopper dredge disposal area is the best suited location available within reasonable distance of Charleston Harbor for the deposition of non-toxic materials. Disposal in this area has resulted in no significant conflicts with commercial or recreational fishing interests, as would probably be the case if the site were located farther inshore or offshore."

4.03.6.2.2 Based on data presented above, it is expected that the impact on benthic organisms in navigation channels and in the offshore disposal area will be short-term as organisms destroyed will be replaced by recruitment from adjacent areas. Also, many mollusks inhabiting the benthic environs of the offshore disposal area will likely work their way to the surface after shallow burial and thus will be little affected by dumping operations.

4.03.6.3 Mosquitoes. The use of diked disposal areas to avoid adverse effects on estuarine values has an adverse effect in that diking in the coastal zone creates ideal habitat for mosquitoes, particularly the salt marsh mosquito, Aedes sollicitans. Characteristics of diked disposal areas that make such areas productive of mosquitoes are the elimination of regular tidal flooding and the temporary ponding of water due to uneven settling of dredged material and poor drainage. The cracks that normally form during the drying of disposal areas provide very favorable oviposition sites. Natural controls such as the maintenance of stable water levels or the achievement of rapid drainage would greatly limit the production of mosquitoes in disposal areas, but neither method appears practical because of physical characteristics of the disposal areas and material dredged from the waterway and also because of operation requirements of disposal areas. Although the Corps of Engineers is funding research on mosquito production in disposal areas, mosquito control measures were not provided for in the Acts of Congress authorizing the construction and maintenance of the Charleston Harbor Navigation Project. Mosquito control operations at disposal areas are a non-Federal responsibility and are generally conducted by local government as part of their overall mosquito abatement program. The most commonly used insecticide is Flit M.L.O., an oil larvicide which dissipates quickly and has no effect on important forms of aquatic life. Since Flit has no residual effect, a control program utilizing oil larvicides requires frequent inspection and respraying.

4.03.7 Fish. As stated in Section 2 of this statement, the Charleston Harbor estuarine system supports a diverse array of fishes. Although many of these species are occasionally found in the deeper portions of the estuary, the majority are usually associated with salt marshes and shallow water areas which will not be significantly affected by the proposed project.

4.03.7.01 Available data indicate that fish populations, unlike benthic invertebrates which are relatively immobile and may undergo population reductions that may be locally severe, are less likely to be adversely affected by dredging operations. For example, Stickney (Reference 31) in his study of the Atlantic Intracoastal Waterway in Georgia found no indication of fishes being killed during dredging operations. In some areas, dredging could even be considered to be beneficial to certain species of fish, especially those which prey on the larger benthic organisms. As a dredge works its way along a channel, benthic animals which would normally be buried in the sediments are dislodged and become susceptible to predation. This sudden availability of food quite often results in higher than normal concentrations of fishes near the dredge. Ocean disposal could create a similar situation.

4.03.7.02 Although it would appear that motile organisms are affected to an insignificant degree by dredging, there has been some concern in the last few years over the possible effects of increased turbidities and siltation associated with dredging. As the dredge cutterhead revolves, it creates some type of turbidity plume, the size of which will vary considerably depending on the type

of sediments being dredged, strength of currents and other factors. The magnitude of the impact of suspended particles on fishes will, in most cases, be dependent on the concentration, composition, sorbed minerals or toxins, and the tolerance of a particular species.

4.03.7.03 Sherk (Reference 29) found that, in general, bottom-dwelling species were the most tolerant of suspended solids, filter feeders were most sensitive, and that juvenile forms were more sensitive than adults. Goodwyn, in Chesapeake Biological Laboratory (Reference 28), summarized seasonal and geographical variations in population density and species composition of zooplankton, but apparently none of the variation could be attributed to environmental modification. No indications of mortality attributable to the dredging and disposal operation with respect to fish eggs and larvae in the project area were obtained, although Dovel (in the same report) found larval and juvenile stages of freshwater, estuarine, and marine spawners in that area from April through August. He thought that this was the most critical period for these developmental stages, i.e., when they would be most vulnerable to dredging and disposal. Also, since he found that postlarval and young fishes were present in deeper areas from November through January, he advised that channel alterations should be avoided during that period.

4.03.7.04 Sherk and Cronin (Reference 32) found that under experimental conditions, fish subjected to extremely high concentrations of suspended solids have died from suffocation due to clogging of the gills and opercular cavities. However, under normal circumstances, fish avoid turbid waters and have the ability to clear gill membranes of accumulated silt upon entering undisturbed water. However, as pointed out previously, not all species are equally susceptible to suspended solids and different suspensoids vary in their effect.

4.03.7.05 Sherk (Reference 2) in a more recent study found that, in general, the larval, juvenile, and young-of-the-year forms of marine and estuarine species were much more sensitive to oxygen starvation (anoxia) by sediment contamination than their adult counterparts. This is probably due to a combination of the larger size of the gill filaments of adult fish (trapping fewer particles) and the higher metabolic rates (rapid breathing requirements) of the younger fish. As might be expected, demersal (bottom-oriented) species such as the Sciaenids and hogchoker seem to be more tolerant of such conditions than such periodical inhabitants of mid and upper levels of the water column as herrings, and silversides. Wide-ranging feeders such as the striped bass seem to be in about the middle of the sensitivity range.

4.03.7.06 A lack of oxygen (anoxia) brought about in one of three ways seems to be the cause of death in estuarine fish exposed to high concentrations of suspended sediments similar to those encountered during dredging. Fine particles (smaller than 4 microns in diameter) have been found to coat the gills of fish and prevent oxygen exchange. Slightly larger particles (up to 15 microns) block the lamellae (functional portion) of fish gills, also inhibiting oxygen exchange. Finally, the delicate secondary lamellae can be directly damaged by suspended particles and thereby rendered inoperative to varying degrees.

4.03.7.07 In addition to death by anoxia, a number of sublethal effects, including changes in blood chemistry, gill structure, and pH of the digestive tract have been identified as occurring at significantly lower levels of suspended particle contamination than those required to produce death. Other estuarine organisms, particularly shellfish and zooplankton have exhibited physiological reactions during laboratory exposure to suspended sediment concentrations comparable to those typically associated with dredging operations.

4.03.7.08 Goodwyn, in Chesapeake Biological Laboratory (Reference 28), summarized seasonal and geographical variations in population density and species composition of zooplankton, but apparently none of the variation could be attributed to environmental modification. No indications of mortality attributable to the dredging and disposal operation with respect to fish eggs and larvae in the project area were obtained, although Dovel (in the same report) found larval and juvenile stages of freshwater, estuarine, and marine spawners in that area from April through August. He thought that this was the most critical period for these developmental stages, i.e., when they would be most vulnerable to dredging and disposal of dredged materials. Also, since he found that post-larval and young fishes were present in deeper areas from November through January, he advised that channel alterations should be avoided during that period.

4.03.7.09 As general rule, it has been found that fish can tolerate high turbidities except when they are accompanied by low levels of dissolved oxygen, acids, alkalies, or other substances which may interfere with respiration, injure gills or prevent their normal function, and, although Stickney found they generally did not leave the immediate dredging area, they are quite capable of doing so.

4.03.7.10 Turbidity plumes created by maintenance dredging are primarily restricted to the channel area with some adjacent shading depending on wind and tidal velocities. As mentioned previously, fish species which have the highest probability of being affected are the filter feeders (principally menhaden, herring and shad) and juvenile forms. Estimates of the relative abundance of these species in the channel area at any given time varies so that it is not practical to attempt a precise determination of impact on these species. Based on (1) research which has been accomplished in other areas and (2) available information on the effects of current maintenance dredging practices in the harbor, it is felt that the impacts resulting from continued maintenance dredging will be of a short-term, localized nature and will not significantly affect the fish stocks in the Charleston estuarine system.

4.03.7.11 Larval fish. The National Marine Fisheries Service, under contract to the U. S. Army, Corps of Engineers, studied the effects of dredged harbor sediments on larval estuarine fish

common to Charleston Harbor as part of the estuarine values study (Reference 33). Their final report was submitted to the Corps in April, 1973 and is summarized in the following paragraphs.

4.03.7.11.1 For this study, the NMFS exposed the larvae of five species of estuarine fish (Atlantic menhaden, pinfish, flounder, spot, and Atlantic croaker) to seawater-sediment extracts for periods of up to 14 days. Sediments for the study were collected by the Corps of Engineers at pertinent stations in the harbor. In the NMFS laboratory, the sediments were added to filtered seawater, shaken for two hours, and allowed to settle. The supernatant was then diluted for testing at seven concentrations ranging from 0 to 100%.

4.03.7.11.2 The general conclusions reached by NMFS are as follows: "Despite the shortcomings imposed by limited time and money, certain general conclusions can be drawn from this research. Though we have not determined the toxicant (or toxicants) present in the extract, it is obvious that the materials are soluble in seawater and that the leaching of these unknown compounds into the water column may be detrimental to larval fish populations under certain conditions. This was demonstrated in the bioassay tests where survival of larval fish was quite low or zero at certain high concentrations of sediment extract. Indications are that survival of larval fish will be different for different species. We also found a relative difference in toxicity of the sediments depending on where the sample came from in Charleston Harbor. Of the samples we tested, those from Station 5, Shipyard River, and Station 8 were the most acutely toxic.

In addition to the acute response (mortality) our results also indicate that sublethal mechanisms are acting to cause physiological changes in the larval fish. This change is observed as a reduction in the growth rate of the larval fish at certain concentrations of the sediment extract. This lack of growth would suggest an overall weakening of the fish which in turn could affect the fishes' chance for survival.

Our behavioral test did not provide enough data to draw any conclusions. We feel, however, that our test of behavioral responses to sediment extract indicated that menhaden and flounder may be affected behaviorally (which could lead to more substantial ecological effects) and these organisms should be tested further using this criteria."

4.03.7.11.3 The above study presents evidence that larval forms of certain fish species may be adversely affected by Charleston Harbor maintenance dredging and that some mortality will no doubt occur. However, since these laboratory data are not directly applicable to field situations, the impacts cannot be quantitatively evaluated. Some larval fish will be destroyed either as a result of (1) the mechanical action of the dredge, (2) being exposed to turbid water, or (3) being exposed to toxic substances in sediments. However, as

stated previously, any impacts will be temporary and will be limited to the immediate vicinity of the dredge or disposal areas and will not significantly affect fish stocks in the Charleston Harbor estuarine system.

4.03.7.12 Commercial fisheries. As discussed in Section 2, the principal species marketed in Charleston are shrimp, blue crabs, oysters, clams, alewives, American eels, flounder, whiting, black sea bass, and spot. A majority of these species are captured in offshore fisheries which will not be affected by the proposed project. Oysters and clams are found in shallower areas of the harbor and will not be affected by the project. The clams and oysters marketed in Charleston come from other areas along the coast. Shrimp and blue crabs are found throughout the estuary and there is a possibility that some may be killed if they come in contact with the dredge cutterhead. However, the impact will be temporary and will not significantly affect recruitment to the inshore or offshore fisheries.

4.03.7.12.1 Many of the commercial fish species spend a portion of their life cycle in the estuary and could be adversely affected by turbidities or could be picked up by the cutterhead. As discussed in Section 4.03.7, the impact on fish is expected to be temporary and insignificant.

4.03.8 Rare and endangered species. A list of endangered, threatened, peripheral and status undetermined species is found in Section 2.12.2.4. To the extent that upland disposal sites are used in lieu of marshlands, those species using uplands near rivers and coastal bays could experience some loss of habitat. There is no reason to believe that the other species listed would be affected by continued maintenance of project channels. The cooperative interagency efforts described in Section 1.04.1 should prevent excessive loss of this habitat where crucial to rare and endangered species.

4.04 Archaeological and historical sites. Maintenance of the Charleston Harbor project channel would have no impact on archeological or historical resources. Charleston Harbor required significant dredging only after the completion of the Santee-Cooper Project in 1942 by the State of South Carolina. Since most of the material to be dredged from the harbor is sediment deposited since 1942, there is little likelihood of disturbing anything of historical value. Any archaeological resources which might have been present were probably removed during excavation for the 35-foot project. The National Register of Historic Places has been consulted and no Register properties will be affected by the proposed project. The project will not result in the transfer, sale, demolition, or substantial alteration of potential National Register properties. Cooperative efforts toward site disposal selection as described in Section 1.04.1 should prevent sites of archaeological or historical significance from being used as future disposal areas.

4.05 Aesthetics. Prior to the actual dredging, it is usually necessary to raise the dikes enclosing the disposal areas by using material from within the diked disposal area. These dikes will then consist mainly of barren earth which will contrast in an unfavorable manner with surrounding areas that are fully vegetated.

A barren appearance within the disposal area will also prevail for some time after dredging. Natural vegetative regrowth on the dikes and within the disposal area will commence soon after dredging is completed and a relatively full vegetative cover of grasses and herbs may be achieved within a few months. The attainment of a full vegetative cover will present a more natural appearance to the diked disposal areas, and will restore to some extent the aesthetic values that were lost during the dredging operation. The presence of the dredge boat and pipelines and associated equipment in the harbor will represent an intrusion upon the view of the harbor during the period of dredging. This impact would exist only during dredging and is considered of lesser magnitude than the aesthetic impact associated with the disposal of dredged material in diked disposal areas.

4.06 Air quality. There will be a very minor increase in air pollution as a result of operation of the dredge; however, the effects will be temporary as well as insignificant and probably not measurable at existing air quality stations.

4.07 Noise. In view of the large expanse of open water, noise levels from dredge operations during the construction period will not be raised objectionably above present levels.

4.08 Outdoor Recreation. The continued maintenance of the project channels in the Charleston Harbor area will not significantly affect the continued use of the area for waterborne recreation. The dredging operation creates a navigational obstruction (dredge, pipeline, work boats, etc.) which recreational boaters and other vessels have to avoid. In addition, the dredging operation may have an indirect effect on the recreational harvesting of fish in the vicinity of disposal areas.

4.09 Existing projects. The effects of continued maintenance of the Charleston Harbor Project on other Federal projects and other agency projects vary from a lack of any significant effect to some form of enhancement. There will be no direct relationship between the proposed project and the Atlantic Intracoastal Waterway since the dimension of the latter is considerably less than that of the existing harbor. Maintenance of the harbor has no potential of interacting with projects of other agencies except for that aspect associated with the disposal of dredged material. In this regard, there is no consideration given to the use of such areas for disposal of dredged material. Examples of such projects are Fort Sumter and Moultrie of the National Park Service and Hog Island which is the site of a proposed naval museum. The projects effect on the Cooper River rediversion project, Charleston Harbor deepening project and South Carolina State Ports Authority permit application is discussed in the following paragraphs.

4.09.1 Cooper River rediversion project. Continued maintenance of navigation channels within Charleston Harbor will not affect the construction of the Cooper River rediversion project discussed in Section 2.03. However, since the purpose of the rediversion project is to reduce the rate of shoaling in Charleston Harbor, the completion of this project will have a significant affect on future maintenance dredging. It is estimated that within 10 years after completion of the rediversion project, shoaling rates will be decreased by about 70 percent thus reducing the requirements for disposal areas. The rediversion project is currently in the early stages of construction.

4.09.2 Charleston Harbor deepening project. The Charleston Harbor deepening project as discussed in Section 2.03 will not be affected by the continued maintenance of harbor channels. However, the deepening project will increase the annual maintenance dredging requirement by an average 1.7 million cubic yards annually and increase the annual requirement for disposal areas by 49 acres.

4.09.3 South Carolina State Ports Authority. The continued maintenance of navigation channels will not affect the State Ports Authority permit application (see Section 2.04) which is currently being considered by the Corps of Engineers. If the permit is granted and a commitment for construction is made, the Corps of Engineers will consider extending the Federal navigation channel up the Wando River to serve the proposed terminal. If this extension is constructed, initial construction would require the removal of about 3,400,000 cubic yards of material and the annual maintenance would be about 500,000 to 600,000 cubic yards for the channel and 150,000 to 200,000 cubic yards for the terminal. Disposal of these quantities would require about 200 to 250 acre feet of disposal area annually.

5.0 Any Probable Adverse Environmental Effects Which Cannot Be Avoided.

A detailed discussion of all environmental impacts expected to result from the maintenance is contained in Section 4.0. Some of these impacts are considered unfavorable, but cannot be avoided by any practical means within the authority and scope of the work. Such impacts are summarized in the following paragraphs.

5.01 The principal adverse effects will be related to temporary changes in water quality and its effect on the harbor and disposal areas ecosystems and the conversion of remaining marsh inside disposal easements to a highland environment. Water quality changes include increased turbidities and siltation in the vicinity of the dredge and disposal areas; a temporary decrease in primary productivity resulting from turbid waters reducing the euphotic zone; a possible loss of organisms through the leaching of toxic substances from the upland disposal areas; and a possible reduction in dissolved oxygen levels as a result of the dredge disturbing organic materials undergoing anaerobic decomposition.

5.02 In addition, some benthic organisms may be destroyed by the dredge cutterhead and others may be covered in the offshore disposal area. Wildlife species inhabiting disposal areas will be displaced by deposition of dredged materials. As mentioned above, existing vegetation in disposal areas will be killed and regrowth prevented until the use of such areas ceases.

6.0 Alternatives to the Proposed Action

6.01 No action.

6.01.1 This alternative would involve the discontinuation of maintenance of the harbor and the eventual shoaling up of existing channels. Naval facilities along the Cooper River would become inaccessible to many vessels now using these facilities. These facilities are now considered essential to the National Defense effort and if the Charleston Harbor Project is abandoned, similar facilities must be provided elsewhere. Commercial shipping would immediately become curtailed and would in a few years be eliminated as channels shoal to a depth precluding the passage of any seagoing tankers or cargo ships. Facilities and economic patterns that have developed, entirely or in part, as a result of stimulus provided by the Charleston Harbor Project would also be adversely affected if the project were to be suddenly abandoned. This alternative was rejected in order to avoid a significant disruption of the local and statewide economy.

6.01.2 If the Corps of Engineers ceased to maintain the harbor, the Navy would either have to move its facilities or dredge the harbor itself. Dredging by the Navy would increase Federal cost and commercial vessels would still be able to use the port. The closing of Charleston Harbor as an alternative solution to the Cooper River Rediversion Project was only considered briefly as detrimental effects on Charleston and the State of South Carolina were obvious without detail study. South Carolina currently ranks 47th among the states in per capita income with an average of $2,938 or 75% of the national average of $3,920. Charleston County is approximately the same as the state average with $2,953. The closing of Charleston Harbor would, without a doubt, lower the Charleston County figure. The closing of the harbor would have a direct monetary effect on the City of Charleston as every ton of cargo that moves through the harbor brings a specific number of dollars to Charleston. In 1968, the U. S. Maritime Administration published data on the benefits accruing to the economy from port activity. The Maritime Administration's estimate for 1968 shows a "direct benefit" to the community of approximately $18 for each ton of general cargo passing over port facilities. Approximately $10.80 of this amount was attributed to labor cost. Other components included rail and motor freight, $2.16; supplies, $1.80; auxiliary services, $1.44; port and terminal expenditures, $1.08; vessel crew expenditures, $0.36; bunkers, $0.18; and miscellaneous vessel disbursements, $0.18.

The Maritime Administration economic benefit figures are: for bulk cargo and tanker cargo, $4.38; grain $7.06; ore, $3.51, and all others, $1.34. Based on the 1971 tonnage, the monetary loss to Charleston would be $47,000,000. In addition to these direct benefits, there would be an increase in transportation cost to the shippers of the port. Although transportation cost savings are not always the determining factor in the selection of a particular port, it is usually an important one. Transportation costs vary greatly with the type of commerce and any estimate without detailed analysis would be tenuous in nature. Assuming a conservative figure of $2.00 a ton, the closing of the port would increase the transportation cost to shippers approximately $13,000,000 per year. Certain industries are also heavily dependent on the port for raw materials imported and the exporting of finished goods. The prime consideration of the location of these businesses in Charleston was their nearness to the port. All of the impact of these businesses can be attributed to the port. The two major industries considered to be port dependent are chemicals (including fertilizer) and pulp and paper. The impact revenue of these industries approaches $100,000,000.

6.01.3 The closure of the commercial harbor as previously discussed would require the closure of the Naval Base as well. The effect the closure of the Charleston Naval Base would have on the metropolitan economy is virtually incalculable. Some 29,979 civilian and military personnel make up an annual payroll of $309,842,521 at the base. It is estimated that approximately 8,500 of the military personnel are married and put $59,000,000 in the local economy annually. The Navy also spends $24,000,000 annually on non-standard items and utility contracts of which approximately 75 percent of that sum is spent in Charleston, Berkeley, and Dorchester Counties. It has been roughly estimated that the Naval Base accounts for nearly 20 percent of the total economy of the area. The intangible national defense benefits have not been evaluated; however, it should be noted the only Polaris submarine base on the Atlantic seaboard is located at Charleston Naval Base.

6.01.4 The South Carolina State Ports Authority currently has about $40,000 invested in port facilities on Charleston Harbor. They are also expecting to invest another $56,000,000 for facilities on the Wando River. Only a small portion of this investment could be salvaged if the port was closed.

6.02 Dredging alternatives. Studies of existing maintenance dredging operations were conducted in response to Congressional directives to develop a practical long-range solution to the disposal of material dredged from Charleston Harbor with particular reference to estuarine values. Ten plans were evaluated and these are discussed in the following paragraphs. More detailed information on these dredging alternatives is contained in the Report on Long-Range Disposal Study, Charleston Harbor, South Carolina, which is available for review in the Charleston District Office. Since that part of the dredging operation that is concerned only with the removal of the shoal deposits is similar under all plans in that it involves the use of a cutterhead and pipeline, the environmental impacts associated with this part of the overall operation will not be repeated

here. The means and methods of disposal vary and these will be discussed in greater detail. After existing diked areas are filled, no additional marshland will be used for disposal sites in Charleston Harbor. Costs for Plan b were calculated assuming some marsh would be used. Estimates for this plan should be revised upward to include the cost increase due to avoiding fill of all marshland.

Plan 1. Continuation of the presently used method which involves the removal of shoal material by pipeline dredge and permanent disposal in diked areas adjacent to the harbor. This is not considered a viable long-term solution because existing areas are not expected to last long enough even with the expeditious construction of the Cooper River Rediversion project. Other highland areas are not available for this purpose. Because of the importance of marsh habitat in the maintenance of estuarine and marine resources, further use of marsh areas for the disposal of dredged material is considered impractical. The estimated annual cost of this plan is $3,650,000.

Plan 2. Dredging and conveyance of shoal material to an offshore disposal area by hopper dredge. The use of hopper dredges throughout the Charleston Harbor project area is impractical because of the dock areas, restricted channel widths in the upper project area, and the sharp turns in the Navy channels. The estimated annual cost of this plan is excessive when compared with other plans, being $16,864,000. The environmental impacts of this plan on the offshore dumping area would be similar to the impacts of the present offshore dumping operation which is discussed in Sections 2 and 4. The use of hopper dredges in the outer part of Charleston Harbor and the dumping area has not been found to have any significant adverse effect on the dumping area. The use of hopper dredges throughout the harbor project would require that a much greater volume of material be dumped in the ocean. Based on observations of the present operation, it is not believed that the greater volume of material would result in significant adverse effects on ocean bottoms. The material in the upper areas of the harbor is at least as fine or finer than the material now dredged from the outer reaches of the harbor and most of this material would be quickly dispersed as appears to be the case with present offshore disposal operations.

Plan 3. Removal of shoal material by pipeline dredge and the transfer of this material to the Daniels Island disposal area, which would function as a temporary disposal area until the material could be transported to an offshore disposal area by pipeline. The initial dredging would be accomplished by privately-owned dredges under contract and the later transfer of the shoal material to sea would be accomplished by a government-owned and operated unit consisting of a long pipeline into the ocean with electric booster stations as required to cope with the long distances involved. The estimated annual cost of this plan is $4,814,000. The impact on the ocean dumping ground would be similar to that of Plan 2 but a greater accumulation of material might result under this plan since the dumping operation

of the hopper dredge results in the greatest possible dispersion and resuspension of shoal material. Greater accumulations of shoal material would not be significant because this area now consists of fine to coarse sand and shell and its natural productivity is relatively low. There would be no significant environmental impacts resulting from the use of an existing disposal area on Daniels Island as a temporary disposal area. The pipeline and booster stations will be routed through open water areas and would not have significant impact on water bottoms.

Plan 3A. This plan is identical to Plan 3 except that diesel powered booster units would be used instead of electric power units. The estimated annual cost of this plan is $4,879,000. Its environmental impacts would be similar to those of Plan 3.

Plan 4. Removal of shoal material by pipeline dredge and the transfer of this material to the Daniels Island disposal area and Area I just above Goose Creek, which areas would function as temporary disposal areas until the material could be transported to an offshore disposal area by pipeline. This plan is identical to Plan 3 except that approximately 20 percent of the shoal material would be initially pumped into Area I instead of entirely into the Daniels Island disposal area. This plan was developed in an effort to reduce costs by using a temporary area closer to the shoals in the upper part of the harbor project. The estimated annual cost of this plan is $4,759,000. Its environmental impacts would also be similar to that of Plan 3.

Plan 4A. This plan is identical to Plan 4 except that diesel powered booster units would be used instead of electric power units. The estimated annual cost of this plan is $4,821,000. Its environmental impacts would be similar to those of Plan 4.

Plan 5. Removal of shoal material by pipeline dredge and the transfer of this material to the Daniels Island disposal area, which would function as a temporary disposal area until the material could be transported to an offshore disposal area by barge. The estimated annual cost of this plan is $5,325,000. The environmental impacts of this plan most closely resemble those of Plan 2 in that under both plans, all of the dredged material is transported to the offshore disposal area where it would be discharged at the waters surface.

Plan 6. Removal of shoal material by pipeline dredge and the transfer of this material to the Daniels Island disposal area and Area I just above Goose Creek, which areas would function as temporary disposal areas until the material could be transported to remote inland disposal areas by pipeline. This plan is similar to Plan 4 except that the material would be transported to diked inland disposal areas instead of to the offshore disposal area. The tentative location of inland disposal areas is along the Wando River. Most of these areas would be highland but some higher marshland would be included. Major tidal creeks would be avoided. This represents a

compromise between economics (land costs) and marsh preservation. The estimated annual cost of this plan is $4,247,000. Complete avoidance of all marshland would increase the costs of this plan. All vegetation in these disposal areas would be killed and those areas would lose what value they may have as wildlife habitat. Each area may be used for some years so that this loss represents a fairly long-term commitment. When filled to capacity, these areas will be revegetated and eventually tree growth characteristic of upland habitat will become established. In the upland areas, this tree growth may be similar to the natural growth present before their use as disposal areas. The use of high marsh areas will result in their permanent conversion to upland tree habitat after they have been used to capacity. The loss of this high marsh represents a loss of some of the least productive of estuarine areas. The upland habitat that would be taken out of productivity for a relatively long time is a common habitat type throughout the area.

Plan 7. This plan is similar to Plan 6 except that the dredged material would be transported to the remote inland disposal areas by truck instead of by pipeline. The estimated annual cost of this plan is $10,672,000, which is considered excessive in comparison with other plans. The environmental impacts would also be similar to those of Plan 6.

Plan 8. Removal of shoal material by a special dredge designed to utilize barges and the use of these barges to convey the material directly to the offshore disposal area. This plan is similar to Plan 2 except that the dredged material would be transported to the offshore disposal site by barge instead of by hopper dredge. The estimated annual cost of this plan is $2,710,000. The environmental impacts would also be similar to those of Plan 2.

7.0 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

7.01 The principal long-term effect of the project relates to its continued stimulus of the local and regional economy. The continued maintenance of the harbor would permit the use of the harbor by vessels which would otherwise have to use other ports to the detriment of Charleston and the state of South Carolina.

7.02 The principal short-term effects of the project relate to the actual dredging of Charleston Harbor by hydraulic dredge and the disposal of the material in remote disposal areas. Since the first feature represents the removal of recently deposited and unconsolidated fine sediments having little utility to any important life forms, the actual dredging would not conflict with long-term uses. The action of the cutterhead dredge would have temporary and localized effects on water quality which are not considered to be of a magnitude to affect long-term productivity. If inland disposal areas are used, the effluent from such areas would also have a temporary and localized effect on water quality.

7.03 The disposal of the material dredged from the harbor has some potential for long-term consequences depending on the means and methods taken for its final disposal. Two methods have been considered. The one having offshore disposal of all dredged material has little potential for affecting any long-term uses. The other method which involves the disposal of dredged material in remote inland sites will result in long-term losses of natural areas and the utility these areas may have for wildlife. These areas have not been definitely selected, but would not include any areas that are unique or have outstanding value in any particular resource.

8.0 Any Irreversible and Irretrievable Commitments of Resources Which Would Be Involved In the Proposed Action

The project will not cause any known significant curtailment of the diversity and range of beneficial uses of the local environment. Certain resource commitments will be required for the disposal of material dredged from the harbor. Upland disposal areas will undergo a change from a naturally vegetated condition to a non-vegetated state which will persist during the period they are used for disposal of dredged material. When used to capacity, these disposal areas will go through a vegetative succession beginning with grasses and herbs and ending with tree growth that will probably consist of pine and mixed hardwoods. There would be no permanent commitment of resources in the offshore disposal area. The proposed project will involve a total commitment of the gasoline and oil required for dredge operations during the construction period.

9.0 Coordination With Others

9.01 In response to a request to the U. S. Fish and Wildlife Service for an evaluation of the effects of dredging and of various disposal methods on the area ecosystem, the Service formed an ad hoc committee of experts in affected natural resource fields to develop and coordinate a plan of study and to evaluate the results of these studies. As a result of the recommendations of this committee, the following reports were prepared under contract to the U. S. Army Corps of Engineers.

a. A report on regional and local stratigraphy and sedimentation in the Charleston Harbor area, Department of Geology, University of South Carolina, D. J. Colquhoun.

b. Bioassay studies, Charleston Harbor, South Carolina; and the effects of dredging harbor sediments on plankton, Belle W. Baruch Coastal Research Institute, University of South Carolina.

c. Effects of dredged harbor sediments on larval estuarine fish common to Charleston Harbor, South Carolina, National Marine Fisheries Service, Beaufort, North Carolina.

d. A study of the Charleston Harbor Estuary with special reference to deposition of dredged sediments, Office of Marine Conservation, Management and Services, South Carolina Wildlife and Marine Resources Department.

9.01.1 Based on these special contracted studies and the Corps' long-range disposal study, the U. S. Fish and Wildlife Service made the following recommendations concerning dredging and disposal practices:

1. Disposal of dredged material within the confines of the harbor or its adjacent marshlands be discontinued;

2. The most desirable method of disposing of dredged material from an ecological basis is at sea via special dredge and barge (Plan 8). Further, implementation is conditional to the favorable findings of a small scale pilot program indicating the dredged material can be properly transported and disposed of at sea; and

3. The most desirable alternative to sea disposal environmentally would be disposal in diked areas located inland above the marshes. The best plan accomplishing both the economical and environmental considerations would be Plan 6 of the long-range disposal study.

The disposal method eluded to in number 2 above is not only the most desirable but also the most economical.

9.01.2 A draft EIS was distributed for review on 23 May 1975. All letters of comments are attached to this EIS. A circled number follows each comment which requires a response. A corresponding number was assigned to the appropriate response. Responses to these letters of comment are contained in the following section.

9.01.3 Responses to Government Agencies

U. S. Department of Interior

The draft EIS was coordinated with the State Historic Preservation Officer. Also see Section 4.04.

U. S. Environmental Protection Agency

1. Eight water quality sampling stations were established for the study cited in Charleston Harbor, the Wando River and Hobcaw Creek. Of a total of 80 samples, only two exceeded the proposed EPA standards for mercury of 2.0 ug/l. Analysis of these two samples showed levels of 3.0 and 3.1 ug/l. The 80 readings averaged 0.73 ug/l. In view of the lower detectable limit for the method of analysis performed, the degree of accuracy within the range of values measured and the

distribution of readings as discussed below, we do not feel that the mercury levels in the Wando River indicate a potential pollution problem. Collection of samples was divided into two major time periods, a 12-day period in January 1973 and a 12-day period in August 1973. Values in the first period varied erratically between 0.1 ug/l and 3.1 ug/l. The two values that exceeded the proposed standard of 2.0 ug/l were both recorded on the same day along with six other relatively high readings. Samples at the same eight sites on the day before yielded a highest value of 0.5 ug/l. Samples of the same sites the day after the high readings showed a high value of 0.8 ug/l. All of the samples analyzed during the second period showed levels of mercury less than 0.5 ug/l, except for 3 samples (0.6 ug/l, 0.7 ug/l and 0.8 ug/l). This distribution of values indicates that the few high values were discrepancies in methods of analysis rather than representative values. Sediment sample analysis indicated no mercury in the sediments. EPA studies found no sources of mercury discharge in or adjacent to Charleston Harbor. A temporary "slug" passing through the river is, therefore, highly unlikely.

2. The section referred to in this comment is a direct quote from the reference cited. We cannot make changes in the quoted passage, but have added footnotes to include EPA's comments.

U. S. Department of Commerce

1. Many of the assumptions in the article cited were oversimplified, such as the assumptions that all nutrients from secondary treatment would reach marsh-estuary areas (Table 4) or that all of the nutrients which do pass through marshes are removed (Table 5). Unlike a true tertiary treatment system which has little dissolved nutrient in the effluent, marsh-estuary areas owe a great deal of nutrient removal to simple flushing action. Nor is that portion assimilated by marsh 100% effectively removed from the system. Some nutrients are returned as dissolved organic nutrients. This is valuable to the estuarine biota, but does not constitute true tertiary treatment.

2. See addition to Section 2.12.5.2.

3. The possible impact on water quality as described in this comment by DOC would be a direct result of the Cooper River Rediversion Project, and would occur regardless of the actions proposed in this EIS. Only those impacts due to maintenance and dredging and disposal of dredged material are discussed in Section 4.0, "The Probable Impact of the Proposed Action on the Environment". Water quality changes due to rediversion were discussed in the EIS for that project.

4. The study cited in Section 4.03.6.1 is not included to describe a situation in all ways identical to Charleston Harbor, but to describe two methods by which recolonization occurs: (1) suspension and subsequent resettling of invertebrates and (2) erosion and slumping of steep slopes carrying invertebrates into the channel. Neither process is depth dependent. That

recolonization by invertebrates in dredged areas of Charleston Harbor takes place is supported by trawling by personnel of the S. C. Wildlife and Marine Resources Department. During their January 1974 trawl sampling at a station off the Columbus Street terminal, the trawl retained several chunks of bottom sediments from an area reportedly dredged to 40 feet less than one month prior to the sampling date. These benthic samples contained an abundance and diversity of worms (mostly polychaetes), mud crabs, and bivalve mollusks comparable to that of numerous preserved samples from undredged areas.

U. S. Department of Commerce, Coastal Zone Management

1. Frequent mention is made throughout the EIS of the coastal zone, its location, geology, hydrology, soils, biological resources, water quality, etc.

2. The maintenance of the harbor will have few effects on surrounding land use. Those impacts that occur, such as use of upland sites for disposal of dredged material and effects of dredging on water quality and biota are discussed at length in the EIS.

3. Requests for comments from all state agencies are handled through the South Carolina State Clearinghouse, which requests comments from specific cognizant agencies. All responses received from the State Clearinghouse including comments from the South Carolina Department of Wildlife and Marine Resources are included in this EIS. Coordination among State agencies is a State matter.

Forest Service, USDA

1. The effects of the Cooper River Rediversion Project have been discussed quantitatively in Sections 2.03.2, 2.03.2.1, 2.03.2.4, 2.03.2.5 and 4.09.1 of the draft EIS. River flow rates in cfs and disposal areas required in acres are given with and without the rediversion project. Table 2 gives the expected dredging rates in C.Y. with and without rediversion, broken down for 21 reaches. The time required to achieve the expected 70% reduction in dredging requirements is also stated. The effects of dredging and disposal of dredged material are discussed qualitatively in Section 4.0. By applying the above quantitative reductions to the effects discussed in Section 4.0, the impacts of rediversion can be readily derived.

2. U. S. Forest Service lands have been identified as Francis Marion National Forest in the Final EIS. Only brief mention is made of recreational use, as the distance of the National Forest boundaries from the Charleston Harbor project preclude any impact on recreation from the proposed maintenance (see comment by S. C. Department of Parks, Recreation and Tourism).

Commander, Naval Base, Charleston, S. C.

1. Change made as suggested.

2. Changes made as suggested.

Department of Health, Education, and Welfare

No response is required.

Department of Housing and Urban Development

No response is required.

Federal Power Administration

No response is required.

U. S. Coast Guard

No response is required.

Soil Conservation Service, USDA

No response is required.

Federal Highway Administration, USDT

No response is required.

South Carolina State Ports Authority

1. We have included thses tables in the final EIS as tables 20, 21 and 22, and made reference to them in Section 2.13.1.

2. Response is made here to both paragraphs numbered (2) and to the concern expressed throughout the State Ports Authority's comments in regard to the substantial adverse effects of not maintaining the harbor. The EIS concisely states these effects in Section6.01.1 as loss of access to naval facilities, elimination of commercial shipping, and disruption of the local and state economics. Because this alternative was rejected, we did not describe these adverse impacts in greater detail. Impacts from the proposed plan, which are not hypothetical but will probably occur, received more attention. See revisions to Sections 6.01.2, 6.01.3 and 6.01.4.

3. See revisions to Section 2.13.2.4.2.

S. C. Department of Parks, Recreation, and Tourism

No response is required.

South Carolina Wildlife and Marine Resources Commission

1. Correction made.

2. See revision to Section 2.12.5.1.

3. Section 4.0 of the draft EIS included a discussion of the proposed dredging on fish in general and further described which species and which age groups would be most and least affected by dredging. Striped bass and herring were specifically mentioned in Section 4.03.7.05. Shad and herring were specifically mentioned in Section 4.03.7.10.

Yearly maintenance on the project has been performed for years with no drastic effect on shad, herring or striped bass, or minor effects other than those described in Section 4.0. A decline in the herring run has taken place in recent years in the Cooper River. Information from the U. S. Fish and Wildlife Service shows that the decline has taken place since 1969 and is not unique to the Cooper River or to South Carolina. Overfishing in international waters, overfishing in inland waters during the annual spawning run, pollution of rivers and estuaries, destruction of habitat, denial of access to spawning areas and natural fluctuation in abundance were cited as factors responsible for the decline.

Dredging is not considered to be a serious contributing factor. Maintenance has been performed since the original construction, but the decline has taken place only in very recent years. Also the decline has occurred in areas where no dredging takes place.

South Carolina Water Resources Commission

Typographical errors have been corrected.

South Carolina Department of Health and Environmental Control

We acknowledge SCDHEC's preference for Plan 8. Until such time as the specialized equipment necessary is available, disposal will take place in existing disposal areas or new upland areas. Mosquito control, as in the past, is the responsibility of the local sponsor, South Carolina State Ports Authority.

LIST OF REFERENCES

1. Colquhoun, D. J. 1972. Charleston Harbor, South Carolina, estuarine values study. Contract DACW60-71-C-0007. Department of Geology, University of South Carolina.

2. Arthur D. Little, Inc. 1974. Analysis of environmental impacts of port development. Final Report to the S. C. State Ports Authority. Vol. I, II-A, and II-B.

3. Bond, T., D. Chapell, and D. J. Colquhoun. 1969. The continental submerged cycle of sedimentation through examination of the Santee Sangamon submergence. Geological Society of America. Abstracts with programs, 4.

4. Malde, Harold E. 1959. Geology of the Charleston phosphate area, S. C. U. S. Geological Survey Bulletin No. 1079.

5. Cooke, C. Wythe. 1936. Geology of the coastal plain of South Carolina. U. S. Geological Survey Bulletin No. 867.

6. Gibson, Henry E. 1974. Charleston area sediment samples, January 2, 1973. S. C. Pollution Control Authority, In: Cooper River Environmental Study, Report No. 117, Frank P. Nelson, Editor.

7. Gardner, R. A. and P. W. Johnson. 1973. Water supply evaluation and proposed comprehensive study of the Charleston-Bushy Park industrial complex, S. C. U. S. Geological Survey. In: Cooper River Environmental Study, Report No. 117. Frank P. Nelson, Editor.

8. Anonymous. 1966. A report on the water quality of Charleston Harbor and the effects thereon of the proposed Cooper River rediversion, Federal Water Pollution Control Administration, Southeast Water Laboratory. In: Appendix F, Survey Report on Cooper River, S. C., U. S. Army Engineer District, Charleston.

9. Anonymous. 1974. Stream classification for the State of South Carolina. S. C. Pollution Control Authority.

10. Anonymous. 1973. Water quality portion of the Cooper River environmental study. U. S. Environmental Protection Agency, Surveillance and Analysis Division. In: Cooper River Environmental Study, Report No. 117. Frank P. Nelson, Editor.

11. Anonymous. 1973. Wando River environmental quality studies, an interim report. S. C. Water Resources Commission.

12. Anonymous. 1972. A study of the Charleston Harbor estuary with special reference to deposition of dredged sediments. S. C. Marine Resources Department, Contract No. DACW60-71-C-0014.

13. Lunz, G. R. 1967. Unpublished report to the S. C. Water Resources Commission.

14. Lunz, G. R. 1968. Farming the salt marshes. Proceedings of Marsh and Estuary Management Symposium, Louisiana State University, Baton Rouge, La. p. 172-177.

15. Odum, E. P. and A. A. de la Cruz. 1967. Particulate organic detritus in a Georgia salt marsh estuarine ecosystem. In: Estuaries. Lauff (ed), AAAS Publication No. 53. p. 383-388.

16. Teal, J. M. 1962. Energy flow in the salt marsh ecosystem of Georgia. Ecology 43(4): p. 614-624.

17. Smalley, A. E. 1959. The growth cycle of Spartina and its relation to the insect population in the marsh. Proceedings of Salt Marsh Conference, Marine Institute, University of Georgia, Sapelo Island, Ga. p. 96-100.

18. Pomeroy, L. R. 1959. Algae productivity in salt marshes of Georgia. Limnology and Oceanography 4(4): p. 386-398.

19. Wass, M. L. and T. D. Wright. 1969. Coastal wetlands of Virginia. Special Report in Applied Marine Science & Ocean Engineering. Virginia Institute of Marine Science. 149 p.

20. Williams, R. B. and Murdoch,..,1969. The potential importance of Spartina alterniflora in conveying zinc, manganese and iron into the estuarine flood chains. In: Proceedings of Second Symposium on Radioecology. D. J. Nelson and F. C. Evans, eds., U. S. Atomic Energy Commission, RID 4500. 774 p.

21. Marshall, D. E. 1970. Characteristics of Spartina marsh which is receiving treated municipal sewage wastes. Annual Report 1969-70 to National Science Foundation, Sea Grants Project Division. p. 317-359.

22. Shaw, S. P. and C. G. Fredine. 1956. Wetlands of the United States. U. S. Fish and Wildlife Service Circular 39. 67 p.

23. Anonymous. 1973. Threatened Wildlife of the United States. USDI, Bureau Sport Fisheries and Wildlife, Commission of Rare and Endangered Wildlife Species, Resource Publication No. 114.

24. Anonymous. 1964. Biological studies of Charleston Harbor, S. C. and the Santee Rivers, Bears Bluff Laboratories, Wadmalaw Island, S. C.

25. Curtis, Thomas A. 1973. Anadromous fish survey of the Santee and Cooper River systems. Project AFS-3-3. Annual Progress Report for period July 1, 1972 through June 30, 1973. S. C. Wildlife and Marine Resources Department.

26. Turner, William R. and George N. Johnson. 1974. Standing crops of aquatic organisms in tidal streams of the lower Cooper River System. In: Cooper River Environmental Study, S. C. Water Resources Commission, Report No. 117, Frank P. Nelson, Editor.

27. Belle W. Baruch Coastal Research Institute. 1973. Bioassay studies, Charleston Harbor, S. C., the effects of dredging harbor sediments on plankton. Final report submitted to the U. S. Army Corps of Engineers, Charleston District. University of South Carolina, Columbia, Contract No. DACW60-71-C-0009.

28. Chesapeake Biological Laboratory. 1970. Gross physical and biological effects of overboard spoil disposal in upper Chesapeake Bay. Final Report to the U. S. Bureau of Sport Fisheries and Wildlife (Contract 14-16-0005-2096). Reference No. 70-3. Subsections included in this comprehensive report in the order of presentation were as follows:
Cronin, L. E. Summary, conclusions, and recommendations. 15 p.
Biggs, R. B. Geology and Hydrology. Project A. Reference No. 69-23. 36 p.
Flemer, D. A. Phytoplankton. Project B. Ref. No. 69-15. 15 p.
Pfitzenmeyer, H. T. Benthos. Project C. Ref. No. 69-130. 30 p.
Goodwyn, F., Jr. Zooplankton. Project D. Ref. No. 69-128. 9 p.

29. Sherk, J. Albert Jr. 1971. The effects of suspended and deposited sediments on estuarine organisms. Chesapeake Biological Laboratory Contribution No. 443. 73 p.

30. May, Edwin B. 1973. Environmental effects of hydraulic dredging in estuaries. Alabama Marine Resources Bulletin No. 9. 85 p.

31. Stickney, Robert. 1973. Effect of hydraulic dredging on estuarine animals studied. World Dredging and Marine Construction. p. 34-37.

32. Sherk, J. A., Jr., and L. E. Cronin. 1970 The effects of suspended and deposited sediments on estuarine organisms. An annotated bibliography of selected references. Chesapeake Biological Laboratory, Reference No. 70-19. vi +73 p.

33. Hoss, Donald E., Linda C. Coston, and William E. Schaaf. 1973. Effects of dredged sediments on larval estuarine fish common to Charleston Harbor, S. C. U. S. Department of Commerce, National Marine Fisheries Service, Contract No. DACW60-71-C-0011.

34. Smith, Ronald F., Albert H. Swartz, and William H. Massmann. 1966. A symposium on estuarine fisheries. American Fisheries Society, Special Publication No. 3.

35. Sykes, James E. 1968. Commercial values of estuarine generated fisheries on the South Atlantic and Gulf of Mexico coast. In: J. D. Newsom (Editor). Proceedings of Marsh and Estuary Management Symposium. T. J. Moran's Sons, Inc., Baton Rouge, La.

36. U. S. Army, Corps of Engineers. 1966. Spoil disposal study, Charleston Harbor, S. C.

APPENDIX A

"LETTERS OF COMMENT ON DRAFT EIS"

GOVERNMENT AGENCIES

United States Department of the Interior

OFFICE OF THE SECRETARY

Southeast Region / 148 Cain St., N.E. / Atlanta, Ga. 30303

ER-75/896

November 3, 1975

District Engineer
U.S. Army Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Dear Sir:

As requested in your September 8, 1975, letter to the Assistant Secretary, Program Policy, we have reviewed the draft environmental statement for the proposed maintenance dredging of Charleston Harbor, Ashley River, and *U.S. Navy Channels in Cooper River, Charleston and Berkley Counties, South* Carolina, project for project effects on national park areas and historic sites, outdoor recreation, hydrology, geology, and fish and wildlife resources.

We offer the following comments for your consideration.

The draft statement was generally accurate and thorough in addressing fish and wildlife resources and related concerns. Compliance with cultural resource preservation procedures should be initiated at the early stage of project planning. Timely consultation with the State Historic Preservation Officer may avoid unexpected delays in the planning process.

We have no further comments at this time. Thank you for the opportunity to review and comment on the draft statement.

Sincerely yours,

June Whelan

(Miss) June Whelan
Special Assistant to the Secretary
Southeast Region

A-1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

1421 PEACHTREE ST., N. E.
ATLANTA, GEORGIA 30309

November 6, 1975

Colonel Harry S. Wilson, Jr.
District Engineer
Department of the Army
Charleston District, Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

We have reviewed the Draft Environmental Impact Statement for Maintenance Dredging of Charleston Harbor, Shipyard River, Ashley River, and U. S. Navy Channels in Cooper River, Charleston and Berkeley Counties, South Carolina, and find that for the most part, it adequately evaluates the water quality effects of the project.

However, we feel that the mercury data reported for the Wando River samples (pages 26, paragraph 6) were excessively high and indicated a potential pollution problem. (1)

In addition, we question the accuracy of a couple of references given in this paragraph:

1. The proposed U. S. Public Health Service limit for mercury in drinking water is 2.0 ug/l, not 0.5 ug/l.

2. The 96 ppb (not ug/l) value given for the geometric mean for soils in the eastern United States appears to be erroneous (too high), and a background concentration of 0.05 ug/l, not 0.3 ug/l, is considered normal for sea water. (2)

Finally, precautions identified in the Interim Final Guidelines on the discharge of dredged or fill material (Federal Register, Volume 40, Number 173, September 5, 1975) should be used during the project life, or until final guidelines are adopted.

In view of the foregoing, we have given a rating of LO- (lack of objection) to the impact of the action and 2 (insufficient information) to the Impact Statement.

We would appreciate receiving five copies of the final environmental impact statement when it is available, and if we can be of further assistance in any way, please let us know.

Sincerely,

David R. Hopkins
Chief, EIS Branch

A-2

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

November 3, 1975

Colonel Harry S. Wilson, Jr.
Charleston District, Corps of Engineers
Department of the Army
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Reference your draft environmental impact statement entitled "Maintenance Dredging of Charleston Harbor, Ashley River, and U.S. Navy Channels in Cooper River, Charleston and Berkeley Counties, South Carolina". In order to expedite transmittal of the enclosed comments from the National Oceanic and Atmospheric Administration, we are sending them to you in the form in which they were received in this office.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures

Duval Building
9450 Gandy Boulevard
St. Petersburg, FL 33702

October 15, 1975 FSE21/AM

TO: Director
Ofc of Ecology & Environmental Conservation, EE

THRU: for R. L. Schneler
Associate Director OCT 22 1975
Resource Management, F3
W. N. Lindall, Jr.

FROM: for William H. Stevenson
Regional Director

SUBJECT: Review of DEIS #7509.36 - Maintenance Dredging of Charleston Harbor, Ashley River, and the U.S. Navy Channels in Cooper River, Charleston & Berkeley Counties SC (CE)

The subject DEIS, which accompanied EE's memo of September 23, 1975, has been received by the NMFS for review and comment.

Our review has been restricted to those sections of the DEIS addressing project effects on marine, estuarine, and anadromous fishery resources. Segments of the DEIS relating directly or indirectly to fishery resources have also been reviewed.

In our opinion the DEIS adequately describes project related effects to fishery resources which come under the purview of NMFS. We do, however, offer the following specific comments to be addressed in the Final EIS:

2.12 Biological Resources

Page 30, paragraph 2.12.1.03

The DEIS states that, "Nutrients from sewage pollution in years past may have been beneficial in stimulating growth (of Spartina alterniflora) even though the water quality was degraded." The referenced statement demonstrates another extremely valuable use of cordgrass marshes and wetlands in general i.e., as natural tertiary sewage treatment systems. Since the financial importance of this use is more easily visualized, (Gosselink, Odum & Pope, 1974)1/, the DEIS should stress the value of all priority wetlands with regard to their tertiary treatment potential. (1)

Page 39, paragraph 2.12.5.2

We note that oyster larvae, as constituents of the plankton community, also serve as food for larger fish and invertebrates. (2)

4.0 The Probable Impact of the Proposed Action on the Environment

Page 51, paragraph 4.02 Water Quality

Since the Cooper Rediversion Project is closely linked to continued maintenance dredging in the Charleston Harbor, we feel the DEIS should discuss the possible effects of reduced water flows due to rediversion, on the water quality of the Charleston Harbor estuarine system. Due to the large amounts of wastes both industrial and municipal entering the system, reduced water flows down the Cooper River may increase retention time of the various wastes, hence reducing water quality. (3)

Page 4.03.6.1 Invertebrates

The Skidaway Institute of Oceanography study cited in this section does not apply to the project area since different water depths are involved and nearby areas for recruitment of benthos by sloughing actions are absent. It should also be noted that while benthic organisms may recolonize a dredged area the community structure could change thereby reducing the stability of that community. During periods of severe environmental stress the ability of this benthic community to recover could be seriously damaged. (4)

It is requested that one copy of the Final EIS be sent our Area Supervisor, Environmental Assessment Division, NMFS Center, Pivers Island, P.O. Box 570, Beaufort, NC 28516.

cc:
F34, NMFS, Washington, D.C. (3)
FSE211, Beaufort, NC

1/ Gosselink, J.G., E.P. Odum, and R.M. Pope. 1974. The Value of the Tidal Marsh. Center for Wetland Resources, Louisiana State University, Baton Rouge, No. LSU-SG-74-03.

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

November 14, 1975

Colonel Harry S. Wilson, Jr.
Charleston District, Corps of Engineers
Department of the Army
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This is in further reference to your draft environmental impact statement entitled "Maintenance Dredging of Charleston Harbor, Ashley River, and U.S. Navy Channels in Cooper River, Charleston and Berkeley Counties, South Carolina". In order to expedite transmittal of these additional comments from the National Oceanic and Atmospheric Administration, we are sending them to you as they were received in this office.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. As stated in our earlier letter, we would appreciate receiving eight copies of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclsoure: Memo from: Mr. Robert R. Kifer
Coastal Zone Management

A-4

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Rockville Md 20852

Date November 5, 1975 Reply to Attn. of:

To William Aron
EE

From Robert R. Kifer
OCZM

Subject DEIS 7509.36 - Charleston Harbor, Ashley River, and U.S. Navy Channels in Cooper River, Maintenance Dredging

The Office of Coastal Zone Management has the following comments on subject document:

1) There is no mention of the coastal zone of which Charleston Harbor, etc. is a part. (1)

2) There is very little mention of the impacts or effects of harbor maintenance on the surrounding land use. (2)

Specifically, comments do not appear to have been requested from either the Coastal Zone Planning and Management Council or their staff, the Department of Wildlife and Marine Resources. It is important that the input of these organizations be obtained. (3)

As pertains to the impact on land uses, the only specific references are the following:

2.16.1 - historical places
3.0 - existing land use plans
4.08 - waterborne recreation
5.01 and
6.02 - conversion of remaining marshes to highland environment,

which are minimal.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
1720 Peachtree Road, N.W.
Atlanta, Georgia 30309

October 24, 1975

Colonel Harry S. Wilson, Jr.
Department of The Army
Charleston District, Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Here are United States Forest Service, State and Private Forestry comments on the draft environmental statement covering Maintenance Dredging of Charleston Harbor, Ashley River, and U.S. Navy Channels in Cooper River, Charleston and Berkeley Counties, South Carolina.

The statement is made (2.01.1) that the serious shoaling problem is principally due to the San tee-Cooper Project - and that prior to this project, the lower harbor required little maintenance dredging and had natural depths in some areas up to 75 feet. Therefore, the impacts of the Cooper River Rediversion Project on future maintenance dredging of the harbor should be discussed in greater detail, both qualitatively and quantitatively in this statement. (1)

The EIS should recognize the large recreational use of the adjacent Francis Marion National Forest by the people of the Charleston area. We recommend that the U.S. Forest Service owned and managed lands (2.17.3) be identified as the Francis Marion National Forest. (2)

Thank you for the opportunity to review and comment on this good draft EIS.

Sincerely,

ROBERT K. DODSON
Area Environmental Coordinator

A-5

6200 - 11b (4-74)

OFFICE OF THE COMMANDER
NAVAL BASE
CHARLESTON, S. C. 29408

IN REPLY REFER TO NO. AND THE SIGNER OF THIS LETTER, ADDRESS THE COMMANDER NAVAL BASE CHARLESTON, S. C.

REFER TO NO.
Code N3P

From: Commander Naval Base, Charleston, S. C.
To: District Engineer, Dept. of the Army, Charleston District Corps of Engineers, P. O. Box 919, Charleston, SC 29402

Subj: Draft Environmental Impact Statement for Maintenance Dredging

Ref: (a) District Engineers ltr SANGR of 8 SEP 1975

1. Reference (a) invited comments on the draft environmental impact statement.

2. The following comments are submitted:

a. Page 11, para. 2.04.1, last sentence should read "The U. S. Navy also has modern facilities for repair and overhaul of naval vessels including nuclear submarines." (1)

b. Appendix A-35, Table 8, to line "U. S. Navy - Short Stay" add under second column "10,000" and under third column "Activated sludge system." To line "U. S. Navy - Southside" change third column to "Activated sludge system" in lieu of "Stabilization ponds." To line "U. S. Navy Menriv Ponds" add under second column "600,000" and under third column "Oxidation ponds." To line "U. S. Navy Pomflant Ponds" add under second column "75,000 and under third column "Oxidation ponds." (2)

F. R. WALSH
By direction

Copy to:
CHASNAVSHIPYD (Attn: PW Off)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION IV
50 7th STREET, N.E.
ATLANTA, GEORGIA 30323

September 19, 1975

OFFICE OF THE
REGIONAL DIRECTOR

HEW 576-9-75

Harry S. Wilson, Jr.
District Engineer
Department of the Army
Charleston District Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Subject: Maintenance Dredging of Charleston Harbor, Ashley River, and U.S. Navy Channels In Cooper River Charleston and Berkeley Counties, South Carolina

Dear Mr. Wilson:

We have reviewed the subject draft Environmental Impact Statement. Based upon the data contained in the draft, it is our opinion that the proposed action will have only a minor impact upon the human environment within the scope of this Department's review. The impact statements have been adequately addressed for our comments.

Sincerely yours,

Philip P. Sayre
Regional Environmental Officer
DHEW - Region IV

A-6

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGION IV
Peachtree-Seventh Building
50 Seventh Street, N.E.
Atlanta, Georgia 30323

COLUMBIA AREA OFFICE
1801 MAIN STREET, JEFFERSON SQUARE
COLUMBIA, SOUTH CAROLINA 29201

November 11, 1975

IN REPLY REFER TO:
4.3SS, Room 602

Colonel Harry S. Wilson, Jr.
District Engineer, Department of the Army
Charleston District
Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Subject: Draft Environmental Impact Statements
1. Maintenance Dredging of Charleston Harbor in Charleston and Berkeley Counties, S. C.
2. Maintenance Dredging of the Atlantic Intracoastal waterway, between Little River and Port Royal Sound, S.C.

The subject documents have been reviewed by our Area Office Staff, and it is our determination that there will be no effect on any existing or proposed HUD activities. We appreciate the opportunity to have reviewed these documents, and look forward to receipt of the final EIS's as they become available.

Sincerely,

For Franklin H. Corley
Area Director

FEDERAL POWER COMMISSION
REGIONAL OFFICE

730 Peachtree Building
Atlanta, Georgia 30308
October 10, 1975

District Engineer
Corps of Engineers
Department of the Army
Post Office Box 919
Charleston, S. C. 29402

Dear Sir:

We have reviewed the draft environmental impact statement for the maintenance dredging of Charleston Harbor, Shipyard River, Ashley River, and U. S. Navy Channels in Cooper River, Charleston and Berkeley Counties, South Carolina, which was received with your letter of September 8, 1975, your file SANGR.

The Commission's responsibilities relate to the construction and operation of natural gas pipelines under the Natural Gas Act, and the reliability and adequacy of electric service and the development of hydroelectric power under the Federal Power Act.

In reviewing this plan we noted nothing that should interfere with any licensed hydroelectric project under the Commission's jurisdiction. However, any natural gas pipelines or electrical transmission lines in a construction area should be protected.

We appreciate the opportunity to comment on this proposed project.

Very truly yours,

C. L. Fishburne

C. L. Fishburne
Regional Engineer

2cc: Div. Engr.
Atlanta, Ga.

A-7

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to
COMMANDER (mep)
Seventh Coast Guard District
51 S.W. 1st Avenue
Miami, Fla. 33130
Phone: (305) 350 5276

5922/19
3 November 1975

Col. Harry S. Wilson, Jr.
District Engineer
U. S. Army Corps of Engineers
Charleston District
P. O. Box 919
Charleston, S. C. 29402

Re: Corps of Engineers Draft EIS for Dredging of Charleston Harbor, Shipyard River, Ashley River, and U. S. Navy Channels in Cooper River, Charleston and Berkeley Counties, South Carolina

Dear Sir:

The U. S. Coast Guard's Seventh District Office has reviewed the above referenced project and finds no conflicts within our agency's jurisdiction.

Thank you for the opportunity to register our comments. If we may be of any further assistance, please do not hesitate to contact us.

Sincerely,

W. A. MONTGOMERY
Captain, U. S. Coast Guard
Chief, Marine Safety Division
By direction of the District Commander

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
240 Stoneridge Drive, Columbia, South Carolina 29210

September 30, 1975

Colonel Harry S. Wilson, Jr.
District Engineer
Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Appropriate members of my staff have reviewed the draft environmental impact statement for the maintenance dredging of Charleston Harbor, Shipyard River, Ashley River, and U. S. Navy Channels in Cooper River, Charleston and Berkeley Counties. We have no comments on this statement but appreciate the opportunity to review it.

Sincerely,

G. E. Huey
State Conservationist

A-8

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
2001 Assembly Street, Suite 203
Columbia, South Carolina 29201

26 SEP 1975

September 25, 1975

Department of The Army
Charleston District, Corps of Engineers
Post Office Box 919
Charleston, South Carolins 29402

Dear Sir:

Reference is made to your letter dated September 8, 1975 transmitting, for our review and comment, two copies of the draft environmental impact statement for maintenance dredging of Charleston Harbor, Shipyard River, Ashley River, and U. S. Navy Channels in Cooper River, Charleston and Berkeley Counties.

We have reviewed the statement, and no conflicts within FHWA mission areas were noted.

Sincerely yours,

for: W. N. Dulin
Division Administrator

AD-A152 474 MAINTENANCE DREDGING OF CHARLESTON HARBOR ASHLEY RIVER AND US NAVY CHANNE..(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT MAR 76 2/2

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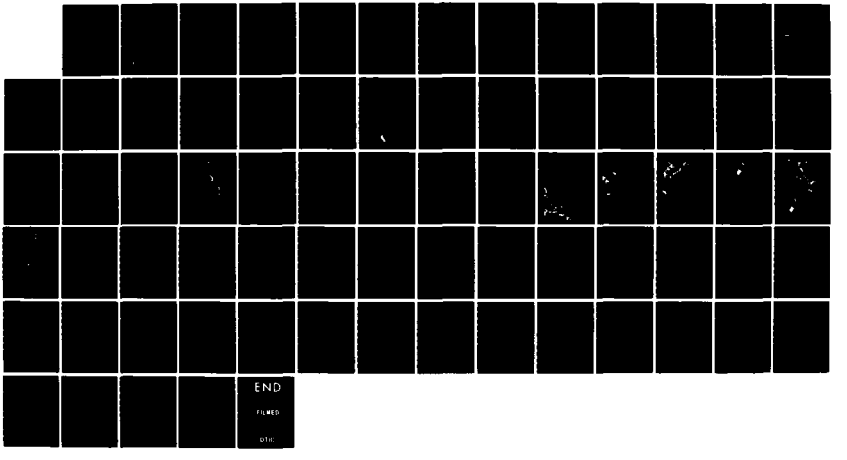

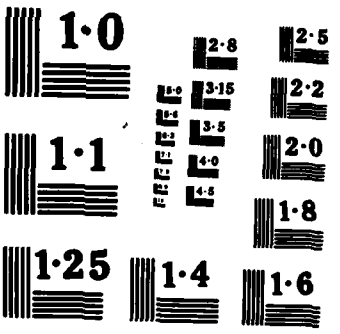
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SOUTH CAROLINA STATE PORTS AUTHORITY
CHARLESTON • GEORGETOWN • PORT ROYAL • PIEDMONT
P.O. BOX 817, CHARLESTON, SOUTH CAROLINA 29402
TELEPHONE 803 723 8651

W. DON WELCH
EXECUTIVE DIRECTOR

October 30, 1975

Colonel Harry S. Wilson, Jr.
U. S. Army Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

RE: Draft Environmental Impact Statement
Maintenance Dredging of Charleston Harbor

Dear Colonel Wilson:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for the maintenance dredging of Charleston Harbor, Ashley River, and U. S. Navy Channels in Cooper River. We have reviewed the Draft Environmental Impact Statement and wish to provide the following comments.

As you know, the National Environment Policy Act of 1969 and your regulations issued in relation to that act provided that economic data received appropriate consideration as an element of the total environmental background. For example, the Corps of Engineers regulation 33 CFR Section 209.410 (d) (i(iii) states that "during Corps of Engineers project planning and the related decision making process, a systematic and interdisciplinary approach will be utilized to insure proper weighing and balancing of environmental effects together with the engineering, economic and social and other considerations affecting the total public interest".

While the Environmental Impact Statement includes substantial information on ecological matters such as the relationship between dredging and water quality and the biological effect of dredge material disposal on marshlands, it has deficiencies in its economic analysis.

I am attaching for your background information a copy of "Impact of the State Ports Authority Upon the Economy of South Carolina" by David R. Pender and Ronald P. Wilder, published by the Division of Research, Bureau of Business and Economic Research, College of Business Administration of the University of South Carolina.

Chapter Four of this study details specifically the role of South Carolina ports in the state and national economy. Table 21, (1)

A-3

table 22 and table 23 break down the involvement of counties throughout the State of South Carolina in import and export trade through the Port of Charleston. These tables show a striking association between port activities and industrial activities in the major industrial areas throughout the state.

In Chapter Five, the study measures the economic impact of the port by estimating the total direct employment and revenues generated by the port. This is activity which would disappear if the port disappeared.

According to the study, employment in the port complex totals 5,066 (table 32). Also as a result of a survey of employers throughout the state, the study determined that employment in firms which view the port as being absolutely essential or of substantial importance to their operations total 104,000, which is about 15% of South Carolina's private-sector employment and about 32% of state manufacturing employment.

Another economic element deserving detailed attention is the economic impact on the Charleston area of the naval facilities along the Cooper River. I am attaching as a reference a current copy of the "Charleston Trident Area Economy at a Glance". This survey shows military and civilian employment at Charleston Naval facilities of 29,979 with a combined payroll of $309,842,521.

Paragraph 2.18.1 of the Draft Environmental Impact Statement (page 50) correctly predicts the physical effects of failure to continue maintenance dredging. The paragraph concludes "local and regional growth expansion would be greatly slowed and the future of the area would be questionable". We submit that little question exists (2) about the future of the state in the absence of an adequate maintenance dredging program. Statewide port-related manufacturing employment of (3) more than 100,000 would dry up and local naval-related employment of nearly 30,000 would disappear. Simply put, that represents economic catastrophe for South Carolina. We believe the Environmental Impact Statement should clearly and unquestionably state this economic prospect.

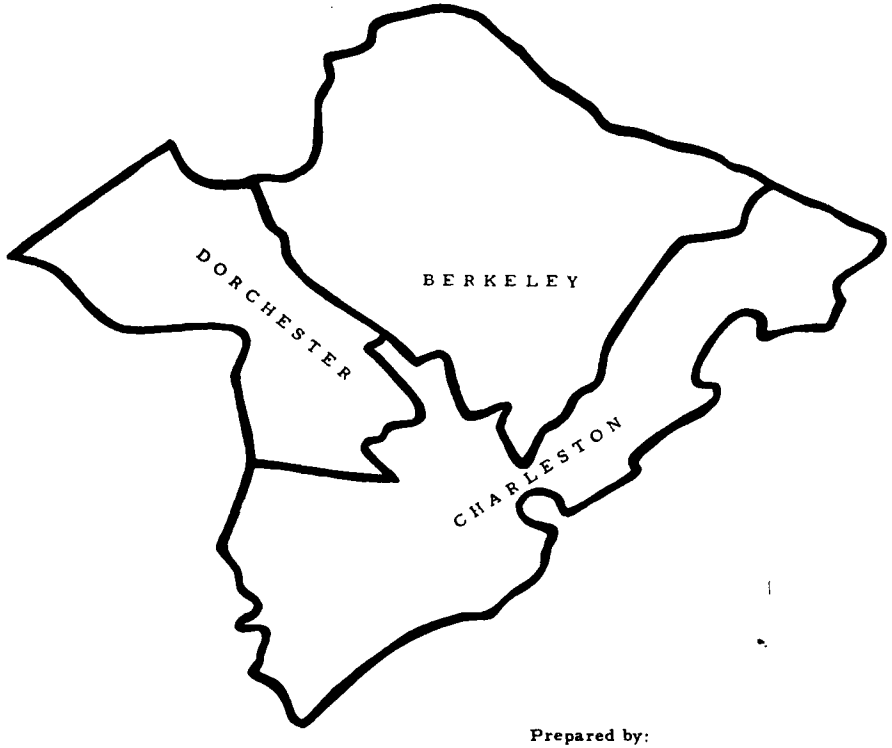
I hope the data we have submitted will assist you in stating more precisely and in greater detail the important economic considerations related to the maintenance dredging project. We appreciate the opportunity to provide comments on this project.

Sincerely,

W. Don Welch

WDW:pji

CHARLESTON
TRIDENT AREA ECONOMY
AT A GLANCE



Prepared by:
MARKET RESEARCH DEPARTMENT
CHARLESTON TRIDENT CHAMBER OF COMMERCE
P.O. BOX 975
CHARLESTON, SOUTH CAROLINA 29402
(803) 577-2510

This publication was designed to provide a brief summary of the Trident Area economy using data accumulated from various sources and Market Research Department estimates. The reader will notice that information pertaining to certain portions of the tri-county area may not appear. This is not an oversite, but reflects the fact that the information was not available for that particular area. When using this data, please state the source.

For additional information pertaining to business conditions and various aspects of life in the Trident Area, please contact the Charleston Trident Chamber of Commerce.

TRIDENT ECONOMY - HISTORICAL SUMMARY

Year	Population	E. B. I.*	Retail Sales	Household Income
1950	217,708	N. A.	N. A.	$ 2,258
1955	244,600	$ 275,562,000	$201,544,000	4,292
1960	278,961	381,405,000	226,991,000	5,499
1961	284,700	409,192,000	219,878,000	5,621
1962	290,400	428,242,000	244,347,000	5,672
1963	296,100	477,009,000	252,503,000	6,100
1964	301,800	527,312,000	289,235,000	6,510
1965	307,500	571,423,000	337,551,000	6,819
1966	313,300	610,017,000	350,047,000	7,052
1967	319,000	652,129,000	365,994,000	7,311
1968	324,700	711,231,000	382,948,000	7,731
1969	330,400	776,680,000	483,693,000	8,183
1970	336,125	842,509,000	499,677,000	8,641
1971	341,400	957,756,000	534,869,000	10,103
1972	354,200	1,100,486,000	627,873,000	10,927
1973	354,100	1,188,436,000	748,120,000	11,651
1974	372,300	1,360,443,000	864,852,000	12,356

*E. B. I. - Effective Buying Income: personal income, both cash income and income in kind, minus federal, state and local taxes.

Source: U. S. Department of Commerce, 1970 Census; Sales Management, "Survey of Buying Power," and estimates made by the Market Research Department of the Charleston Trident Chamber of Commerce.

SURVEY OF RETAIL SALES BY STORE GROUP
FOR THE CHARLESTON SMSA*, 1974

Store Group	Retail Sales ($000) Berkeley	Charleston	Dorchester	Trident Total**
Food, Total	$28,259	$179,939	$20,341	$228,539
Supermarket	28,026	171,656	20,173	219,855
Eating & Drinking Places Total	2,296	42,966	2,384	47,646
General Merchandise, Total	1,906	182,920	2,332	187,158
Department Store	-	124,104	-	124,104
Apparel, Total	4,457	31,426	2,519	38,402
Furn. -House-Appl., Total	2,752	30,533	2,812	36,097
Furn. -Home Furn.	1,576	22,215	1,612	25,403
Automotive, Total	4,046	124,238	21,370	149,654
Gas Station, Total	4,606	46,216	5,970	56,792
Bldg. Mtls. -Hdwre., Total	3,567	44,932	3,101	51,600
Drug, Total	2,240	16,503	1,634	20,377
Miscellaneous, Total	3,848	41,695	3,044	48,587
TOTAL RETAIL SALES	$57,977	$741,368	$65,507	$864,852

Source: Sales Management, "1975 Survey of Buying Power," July 21, 1975.

* The SMSA (Standard Metropolitan Statistical Area), includes Berkeley, Charleston and Dorchester Counties.

** Military Sales of $52,437,000 are not included in the totals above.

SELECTED EFFECTIVE BUYING INCOME STATISTICS
FOR THE CHARLESTON SMSA, 1974

ITEM	Berkeley	Charleston	Dorchester	Trident total
Total E. B. I. ($000)	$168,332	$1,069,884	$122,227	$1,360,443
Per Capita E. B. I.	$ 2,806	$ 3,922	$ 3,094	$ 3,654
Average Household E. B. I.	$ 10,020	$ 13,095	$ 10,537	$ 12,356
Median Household E. B. I.	$ 8,896	$ 10,333	$ 9,462	$ 9,966
Per Cent Households by E. B. I. Groups				
$ 0- 2,999	20.0	16.4	17.1	17.0
3,000- 4,999	7.8	8.2	9.2	8.2
5,000- 7,999	16.2	13.9	15.1	14.4
8,000- 9,999	12.8	9.9	11.9	10.6
10,000-14,999	23.2	22.3	23.6	22.6
15,000-24,999	16.0	22.5	18.9	21.1
25,000 and over	4.0	6.8	4.2	6.1

Source: Sales Management, "1975 Survey of Buying Power," July 21, 1975.

CURRENT POPULATION AND HOUSEHOLD STATISTICS
FOR THE CHARLESTON SMSA, 1974

	Berkeley	Charleston	Dorchester	Trident total
Total Population (000)	60.0	272.8	39.5	372.3
Per Cent White	68.8	67.4	63.8	67.2
Median Age of Population	22.3	26.0	24.2	25.2
Per Cent Population by Age Group				
0- 5 years	12.3	11.4	11.9	11.6
6- 11 years	14.0	10.9	12.1	11.6
12- 17 years	15.3	12.2	13.9	12.9
18- 24 years	13.7	13.6	13.8	13.7
25- 34 years	13.8	17.6	12.8	16.5
35- 49 years	16.4	16.2	16.4	16.1
50- 64 years	10.0	12.1	12.5	11.8
65 years and over	4.5	6.0	6.6	5.8
Total Households (000)	16.8	81.7	11.6	110.1

Source: Sales Management, "1975 Survey of Buying Power," July 21, 1975.

1970 CENSUS POPULATIONS
BERKELEY-CHARLESTON-DORCHESTER COUNTIES

	Berkeley	Charleston	Dorchester	Trident total
Total Population	56,199	247,650	32,276	336,125
Total White	39,044	168,414	20,778	228,236
Total Negro	16,891	77,884	11,319	106,094
Total Male	27,623	126,913	15,779	170,315
Total Female	28,567	120,737	16,479	165,810
Total Population				
Age 0-19	27,530	101,565	14,447	143,542
Age 20-39	15,666	77,687	8,392	101,736
Age 40-64	10,701	54,769	7,459	72,929
Age 65 and over	2,302	13,638	1,978	17,918
Total Male				
Age 0-19	14,001	52,072	7,314	73,387
Age 20-39	7,318	43,546	4,023	54,887
Age 40-64	5,255	26,119	3,830	35,003
Age 65 and over	1,049	5,176	1,165	7,038
Total Female				
Age 0-19	13,529	49,493	7,133	70,155
Age 20-39	8,348	34,132	4,369	46,849
Age 40-64	5,446	28,650	3,830	37,926
Age 65 and over	1,253	8,462	1,165	10,880
Negro Male				
Age 0-19	4,556	19,883	2,788	27,227
Age 20-39	1,555	8,137	1,164	10,856
Age 40-64	1,576	7,330	1,133	10,039
Age 65 and over	468	1,689	327	2,484
Negro Female				
Age 0-19	4,616	19,669	2,824	27,109
Age 20-39	1,699	9,356	1,288	12,343
Age 40-64	1,835	9,103	1,352	12,290
Age 65 and over	586	2,717	443	3,746

Source: U.S. Department of Commerce, 1970 Census.

Note: Population and Housing data is also available by Census Tract through the Market Research Department office.

1970 CENSUS POPULATIONS
INCORPORATED CITIES/TOWNS IN THE TRIDENT AREA

BERKELEY COUNTY	
Bonneau Town	365
Goose Creek Town	3,656
Jamestown Town	190
Moncks Corner Town	2,314
St. Stephen Town	1,506.
CHARLESTON COUNTY	
Charleston City	66,945
Folly Beach Town	1,157
Hollywood Town	339
Isle of Palms Town	2,657
Lincolnville Town	504
McClellenville Town	304
Meggett Town	180
Mount Pleasant Town	6,691
North Charleston City	53,900*
Ravenel Town	931
Sullivan's Island Town	1,426
DORCHESTER COUNTY	
Harleyville Town	704
Reevesville Town	247
Ridgeville Town	563
St. George Town	1,806
Summerville Town	3,839

Source: U.S. Department of Commerce, 1970 Census.

*This figure is a 1974 estimate from the City of North Charleston.

CURRENT AND PROJECTED POPULATION BY FIVE YEAR INTERVALS
BERKELEY-CHARLESTON-DORCHESTER REGION

	1970	1975	1980	1985	1990
Berkeley County	56,199	64,800	77,300	97,600	120,500
Charleston County	247,650	267,000	281,000	293,000	305,000
Dorchester County	32,276	35,200	42,100	54,400	68,900
Total	336,125	367,000	400,400	445,000	494,400

Source: Berkeley-Charleston-Dorchester Regional Planning Council, June 1972.

EMPLOYMENT AND PAYROLL DATA
FOR ALL MILITARY INSTALLATIONS

HISTORICAL TRENDS
(all installations)

Year	Payroll	Active Military	Civilian Employment
1968	$229,957,000	26,989	14,408
1969	317,813,671	23,769	15,174
1970	329,649,000	23,033	13,445
1971	294,723,144*	24,235	13,623
1972	308,995,468	22,209	12,634
1973	304,412,300	22,046	12,664
1974	355,939,466	27,168	11,806
1975	379,347,915	23,039	13,536

* This figure should be used with caution when making comparisons with previous years, as the method of accounting has been altered.

DATA FOR 1975
(all installations)

	Employment		Payrolls	
	Military	Civilian	Military	Civilian
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Air Force	4,547	1,963	47,145,200	20,875,731
Coast Guard	69	17	1,265,734	218,729
Total	23,039	13,536	$224,157,631	$155,190,284

Source: Military Installations, July 1975

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CHARLESTON SMSA EMPLOYMENT SUMMARY

In January, 1974, the South Carolina Employment Security Commission began using revised procedures developed by the U.S. Department of Labor's Bureau of Labor Statistics for preparing uniform labor force and unemployment estimates. The principle change in the data is a shift from a "jobs by place of work" to a "persons by place of residence" concept. A "work force" concept was formerly used to measure total employment and unemployment. Under the "work force" concept, the employment component represented a count of jobs rather than a count of persons. While the difference was relatively small, the job count frequently resulted in an inflated employment level because of dual job holding.

It is important to note that the Nonagricultural Wage and Salary Employment estimates in Table A were derived on an establishment or place-of-work basis, while the Labor Force estimates in Table B were derived on a residence basis.

TABLE A
NONAGRICULTURAL WAGE AND SALARY EMPLOYMENT*

	Annual Average			
	1971	1972	1973	1974**
Total	97,100	101,400	109,300	114,700
Manufacturing	16,200	15,700	15,600	15,800
Durable Goods	8,200	6,900	7,300	7,900
Lumber and wood products	2,100	2,000	1,900	1,800
Other Durables	6,200	4,900	5,400	6,100
Non-durable goods	8,000	8,300	8,300	7,900
Food and kindred products	1,000	1,000	1,000	900
Apparel and other textile products	1,700	2,000	2,100	1,500
Printing and publishing	600	600	600	600
Chemical and allied products	900	900	1,000	1,000
Other non-durables	3,800	3,800	3,700	3,800
Contract Construction	6,300	7,500	8,400	8,800
Transportation, Communication, and Public Utilities	6,100	6,300	6,600	7,400
Wholesale and Retail Trade	19,500	21,000	23,800	24,300
Finance, Insurance and Real Estate	3,900	4,000	4,500	4,900
Service	11,800	12,100	14,000	15,600
Government	33,000	34,800	35,700	37,500
Other Nonmanufacturing	300	600	700	500

*Employment by establishment or place-of-work basis.
**Preliminary: 1974 data will be revised at a later date.

TABLE B
LABOR FORCE ESTIMATE*

	Annual Average			
	1971	1972	1973	1974**
Civilian Labor Force	114,600	117,800	127,200	134,400
Employment, Total	107,000	112,000	121,900	127,400
Nonagriculatural Wage & Salary Employment	94,600	98,700	106,500	111,700
Unemployment	6,900	5,800	5,300	7,000
Percent of Labor Force	6.0	4.9	4.2	5.2

* The labor force data in this table are adjusted to a residence basis, and are not comparable to the "place of work" work force data published previously. Total employment also includes agricultural workers and nonagricultural self-employed, unpaid family and domestic workers.
**Preliminary: 1974 data will be revised at a later date.

TABLE C
AVERAGE EARNINGS AND HOURS IN MANUFACTURING

	Average Hours Worked Per Week			
Industry Group	1971	1972	1973*	1974
All Manufacturing	40.6	41.0	40.6	41.0
Durable Goods	40.8	41.4	40.9	41.4
Nondurable Goods	40.2	40.7	40.3	40.4

	Average Hourly Earnings			
Industry Group	1971	1972	1973*	1974
All Manufacturing	$3.12	$3.16	$3.36	$3.69
Durable Goods	$3.19	$3.08	$3.42	$3.69
Nondurable Goods	$3.05	$3.24	$3.29	$3.71

*Beginning in 1973, figures include Dorchester County. Prior to 1973, figures for Dorchester County were not available.

Source: South Carolina Employment Security Commission, January, 1975.

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DOLLAR VALUE OF CONSTRUCTION FOR WHICH BUILDING PERMITS WERE ISSUED IN CHARLESTON COUNTY

		No. of Units		Dollar Value	
Incorporated Areas	Type	1973	1974	1973	1974
City of Charleston	Single Family Res.	203	203	$4,402,446	$5,544,570
	Multi. Family Res.	82	186	382,000	7,430,000
	Industrial & Comm.	-	-	1,202,096	5,365,929
Folly Beach	Single Family Res.	16	7	212,930	108,117
	Multi. Family Res.	-	-	22,500	-
	Industrial & Comm.	-	-	-	-
Mt. Pleasant	Single Family Res.	196	200	4,429,932	4,512,398
	Multi. Family Res.	19	15	158,800	135,000
	Industrial & Comm.	-	-	1,240,055	1,298,000
Sullivan's Island	Single Family Res.	6	11	180,000	335,000
	Multi. Family Res.	-	-	-	-
	Industrial & Comm.	-	-	-	-
Isle of Palms	Single Family Res.	33	16	779,250	437,600
	Multi.Family Res.	-	-	-	-
	Industrial & Comm.	-	-	-	-
Remainder of County	Single Family Res.	-	-	8,696,816	25,028,764
	Multi. Family Res.	-	-	15,302,924	14,926,170
	Industrial & Comm.	-	-	16,855,440	11,299,731

CHARLESTON COUNTY SCHOOL DISTRICTS

St. James #1: Bordered on the West by the Wando River and Price Creek; on the East by the South Santee River; North by Berkeley County; and on the South by the Atlantic Ocean.

Moultrie #2: Bordered on the North and West by the Wando River; also on the West by Price Creek; on the East by the Cooper River and Charleston Harbor; and on the South by the Atlantic Ocean.

James Island #3: James Island and Folly Beach.

Cooper River #4: Bordered on the South by the Peninsula Charleston City limits; on the East by the Cooper River and Berkeley County; on the North by Dorchester County; and on the East by Dorchester County and the Ashley River.

St. Johns #9: Johns Island, Wadmalaw Island, Seabrook Island, and Kiawah Island.

St. Andrews #10: Bordered on the North by Dorchester County; on the East by the Ashley River; on the South by Wappoo Cut and Elliott Cut; and on the West by the Stono River and Rantowles Creek.

City #20: Peninsula Charleston.

St. Pauls #23: Bordered on the North by Dorchester County; on the East by the North Edisto River, Wadmalaw River, and Rantowles Creek; on the South by the Atlantic Ocean; and on the West by the South Edisto River.

DOLLAR VALUE OF CONSTRUCTION FOR WHICH BUILDING PERMITS WERE ISSUED IN CHARLESTON COUNTY

School District	Type	No. of Units 1973	No. of Units 1974	Dollar Value 1973	Dollar Value 1974
St. James-Santee	Single Family Res.	7	11	$ 63,488	$ 172,300
No. 1	Multi. Family Res.	-	-	-	-
	Industrial & Comm.	-	-	-	12,000
Moultrie	Single Family Res.	283	262	5,979,938	10,715,289
No. 2	Multi. Family Res.	65	45	1,433,800	276,500
	Industrial & Comm.	-	-	1,327,055	2,877,000
James Island	Single Family Res.	175	138	3,251,050	2,927,669
No. 3	Multi. Family Res.	40	152	418,500	2,275,750
	Industrial & Comm.	-	-	45,265	335,600
Cooper River	Single Family Res.	185	166	2,350,214	4,455,477
No. 4	Multi. Family Res.	638	10	3,873,600	1,673,920
	Industrial & Comm.	-	-	10,744,415	45,203,032
St. John's	Single Family Res.	89	78	1,192,275	1,486,402
No. 9	Multi. Family Res.	100	-	2,090,000	-
	Industrial & Comm.	-	-	-	51,000
St. Andrews	Single Family Res.	330	353	3,633,690	14,343,942
No. 10	Multi. Family Res.	756	105	7,993,324	10,790,000
	Industrial & Comm.	-	-	6,839,260	24,998,924
City	Single Family Res.	84	33	1,396,800	966,050
No. 20	Multi. Family Res.	-	148	-	7,475,000
	Industrial & Comm.	-	-	294,945	4,456,104
St. Pauls	Single Family Res.	57	47	833,919	899,520
No. 23	Multi. Family Res.	2	-	3,000	-
	Industrial & Comm.	-	-	46,500	30,000
TOTAL	Single Family Res.	1,210	1,088	18,701,374	35,966,649
	Multi. Family Res.	1,601	460	15,812,224	22,491,170
	Industrial & Comm.	-	-	19,297,440	77,963,660
	Repairs & Alter.*	-	-	7,265,495	6,160,596
	Other	-	-	3,706,166	8,594,462
	Total	-	-	$64,782,699	$151,176,537

*Does not include repairs and alterations for the City of Charleston.

Source: Berkeley-Charleston-Dorchester Regional Planning Council.

Note: Maps of Charleston County are available at a nominal charge from the Map Sales Room 428, SC State Highway Dept., Columbia, SC 29201 (803) 758-3228.

NEW RESIDENTIAL UNITS
FOR WHICH BUILDING PERMITS WERE ISSUED
CHARLESTON COUNTY: 1968 - 1974

School District	1968	1969	1970	1971	1972	1973	1974
St. James - Santee #1	33	30	31	40	27	7	11
Moultrie #2	279	165	376	286	476	348	307
James Island #3	342	214	169	153	281	215	290
Cooper River #4	664	878	580	1317	774	823	176
St. Johns #9	73	85	83	75	100	189	78
St. Andrews #10	681	597	390	1482	816	1086	458
City #20	30	222	16	85	160	84	181
St. Pauls #23	81	70	106	134	124	59	47
ANNUAL TOTAL	2183	2261	1751	3572	2758	2811	1548

Incorporated Area	1968	1969	1970	1971	1972	1973	1974
City of Charleston	106	99	60	137	477	285	389
Folly Beach	11	19	13	10	22	20	7
Mt. Pleasant	NA	NA	NA	NA	333	215	215
Sullivan's Island	6	9	12	12	38	6	11
Isle of Palms	68	34	9	25	46	33	16

Source: Berkeley-Charleston-Dorchester Regional Planning Council.

ESTIMATED IMPACT OF TRAVEL AND CONVENTIONS

1970 Attendance (Tricentennial Year)		
1,300,000 Tourists	@ $24.80 per visit	$32.3 million
35,000 Convention Delegates	@ $35.00 per day (2 days average)	2.5 million
950,000 Business & Others	@ $20.00 per visit	19.0 million
	Total Travellers Income	$53.8 million
1971 Attendance		
1,222,000 Tourists (6% decrease)	@ $20.00 per day (1.5 days average)	$36.6 million
30,000 Convention Delegates	@ $45.00 per day (2.5 days average)	3.4 millio
950,000 Business & Others	@ $22.00 per visit	20.9 million
	Total Travellers Income	$60.9 million
1972 Attendance		
1,385,000 Tourists (13.3 % increase)	@ $25.00 per day (1.5 days average)	$51.9 million
31,500 Convention Delegates	@ $45.00 per day (3 days average)	4.3 million
955,000 Business & Others	@$22.00 per visit	21.0 million
	Total Travellers Income	$77.2 million
1973 Attendance		
1,469,500 Tourists (6.1% increase)	@ $30.00 per day (1.5 days average)	$66.1 million
35,000 Convention Delegates	@ $45.00 per day (3 days average)	4.7 million
995,500 Business & Others	@ $22.00 per visit	22.0 millio
	Total Travellers Income	$92.8 million
1974 Attendance		
1,396,025 Tourists (5% decrease)	@ $35.00 per day (1.5 days average)	$73.3 million
28,000 Convention Delegates	@ $45.00 per day (3 days average)	3.8 million
961,300 Business & Others	@ $25.00 per visit	24.0 million
	Total Travellers Income	$101.1 million

Source: Area attractions and estimates made by the Travel and Conventions Division of the Charleston Trident Chamber of Commerce.

INTER-CITY COST-OF-LIVING INDEX REPORT
Index of 100 = National Average
Fourth Quarter, 1974

City	All Items	Food	Housing	Utilities	Trans.	Health	Misc. Serv.
San Diego, CA	102.8	87.1	116.7	75.6	95.9	130.1	112.4
Denver, CO	100.2	95.6	120.8	91.9	100.1	121.1	94.2
Jacksonville, FL	119.5	106.0	110.8	189.9	98.5	100.4	112.1
Miami, FL	124.1	115.8	150.8	95.0	98.2	137.4	111.4
Macon, GA	96.2	96.1	90.0	128.5	90.2	79.0	90.6
Savannah, GA	105.6	100.5	95.0	152.2	86.1	90.1	118.3
Chicago, IL	101.3	99.8	96.1	94.5	107.6	121.1	108.8
New Orleans, LA	104.3	100.0	99.9	127.9	87.1	115.9	104.1
Winston-Salem, NC	106.8	102.3	114.5	116.8	95.0	96.5	96.2
CHARLESTON, SC	102.9	95.5	89.3	174.1	80.6	90.6	95.0
Richmond, VA	102.7	103.7	99.5	110.3	101.5	102.0	102.8
Rutland, VT	115.8	114.5	107.8	165.0	104.4	106.5	94.0

Source: American Chamber of Commerce Researchers Association, "Cost of Living Indicators."

NATIONAL INFLATIONARY TRENDS IN CONSUMER PRICES
BY CATEGORY 1967 = 100

Category	Jan. '70	Jan. '71	Jan. '72	Jan. '73	Jan. '74	Jan. '75
All Items	113.3	119.2	123.2	127.7	139.7	156.1
Commodities	111.2	115.4	118.7	123.4	137.0	153.4
Food	113.5	115.5	120.3	128.6	153.7	170.9
Housing	114.7	122.7	127.3	131.5	142.2	161.2
Fuel & Utilities	105.1	112.1	118.7	122.8	140.8	160.5
Transportation	109.8	117.5	119.0	121.0	128.1	143.2
Health & Recreation	113.2	119.8	124.3	127.8	133.7	148.9

Source: U.S. Department of Commerce "Survey of Current Business" March, 1971, 1972, 1973, 1974, 1975 Consumer Price Index)

State of South Carolina

Office of the Governor

JAMES B. EDWARDS
GOVERNOR

DIVISION OF ADMINISTRATION
1205 PENDLETON STREET
Columbia, South Carolina 29201

October 14, 1975

Colonel Harry S. Wilson, Jr.
District Engineer
Charleston District, Corps of Engineer
Department of the Army
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

The State Clearinghouse has reviewed the draft environmental impact statement for the maintenance dredging of Charleston Harbor, Shipyard River, Ashley River, and U. S. Navy Channels in Cooper River.

I am enclosing for your consideration in the preparation of the final statement comments from the Wildlife and Marine Resources Department, the Department of Health and Environmental Control, the Department of Parks, Recreation and Tourism, and the Water Resources Commission.

If I can be of any further assistance, please contact me.

Sincerely,

Elmer C. Whitten, Jr.
State Clearinghouse

ECWjr/cs

Enclosures

"Safety Belts Save Lives and Reduce Injuries

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South Carolina
Project Notification & Review System

PROJECT NOTIFICATION REFERRAL

TO: Buddy Jennings
PRT

STATE APPLICATION IDENTIFIER

Clearinghouse Use Only
CONTROL NUMBER
DIST. NO. FY
09 [illegible] 6

SUSPENSE DATE
10/6

The attached project notification is being referred to your agency in accordance with Office of Management and Budget Circular A-95. This System coordinates the review of proposed Federal or federally assisted development programs and projects. Please provide comments below, relating the proposed project to the plans, policies, and programs of your agency. All comments will be reviewed and compiled by the State Clearinghouse. Any questions may be directed to this office by phone at 758-2946. Please return this form prior to the above suspense date to:

State Clearinghouse
Division of Administration
1205 Pendleton Street
Columbia, South Carolina 29201

Signature Elmer C. Whitten, Jr.

Name Elmer C. Whitten, Jr.

RESULTS OF AGENCY REVIEW

- ☐ PROJECT CONSISTENT WITH AGENCY PLANS AND POLICIES
- ☐ AGENCY REQUESTS CONFERENCE TO DISCUSS COMMENTS
- ☑ AGENCY COMMENTS ON CONTEMPLATED APPLICATION AS FOLLOWS:

No particular consequences to the public recreation potential of the area are immediately apparent from this project.

(Use separate continuation sheets if necessary.)

FOR THE REVIEWING AGENCY:
SIGNATURE: [signature] DATE: 9-25-75

TITLE: Engineering & Planning Coordinator PHONE: 795-3634

South Carolina
Project Notification & Review System

PROJECT NOTIFICATION REFERRAL

TO: S. C. Wildlife and Marine Resources Commission
P. O. Box 167
Columbia, SC 29202

RECEIVED
SEP 15 1975
S. C. WILDLIFE & MARINE RESOURCES DEPT.

STATE APPLICATION IDENTIFIER
Clearinghouse Use Only
CONTROL NUMBER
DIST. NO. FY
09 2001 6
SUSPENSE DATE
10/6

The attached project notification is being referred to your agency in accordance with Office of Management and Budget Circular A-95. This System coordinates the review of proposed Federal or federally assisted development programs and projects. Please provide comments below, relating the proposed project to the plans, policies, and programs of your agency. All comments will be reviewed and compiled by the State Clearinghouse. Any questions may be directed to this office by phone at 758-2946. Please return this form prior to the above suspense date to:

State Clearinghouse
Division of Administration
1205 Pendleton Street
Columbia, South Carolina 29201

OCT 03 1975
DIVISION OF ADMINISTRATION

Signature: Elmer C. Whitten Jr.
Name: Elmer C. Whitten, Jr.

RESULTS OF AGENCY REVIEW

OCT 12 1975
DIVISION OF ADMINISTRATION

☐ PROJECT CONSISTENT WITH AGENCY PLANS AND POLICIES

☐ AGENCY REQUESTS CONFERENCE TO DISCUSS COMMENTS

☒ AGENCY COMMENTS ON CONTEMPLATED APPLICATION AS FOLLOWS:

We have reviewed the Draft Environmental Statement for the Corps of Engineers maintenance dredging of Charleston Harbor, Ashley River and U. S. Navy channels in Cooper River and offer the following comments.

In general, the statement provides a complete and accurate assessment of the effects of the proposed project on the marine and estuarine environment. Existing disposal areas will be used for the placement of dredged material.

Specific comments on various sections of the draft statement follows:

(1) On page 29 (2.12.1.01), Smalley (Reference 17) is incorrectly cited. He compared growth of marsh grass with herbivorous insect populations, particularly the grasshopper Orchelimum fidicinium and the leafhopper Prokelisia marginata and made no correlation between

(Use separate continuation sheets if necessary)

FOR THE REVIEWING AGENCY:
SIGNATURE: [signature] DATE: October 2, 1975
TITLE: Executive Director PHONE: 758-6536

HUD Form 7 (4/15/74)

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fish and marsh. It was Teal (Reference 16) who mentioned the link between estuarine animals (i.e., fish) and the marsh. (1)

(2) Uca minax, the red-jointed fiddler crab, is quite abundant in the brackish water marshes of the study area and should be included in Section 2.12.5.1 (page 38). (2)

(3) Section 4.0 should include a discussion of the impact of proposed dredging on the spawning activities of the striped bass, blueback herring, American shad and hickory shad in the study area. (3)

We appreciate the opportunity to review the draft EIS for the proposed project and look forward to receiving a copy of the final statement, when available.

JATjr:cs

South Carolina
Project Notification & Review System

SEP 11 1975

PROJECT NOTIFICATION REFERRAL

TO: Mr. Foster D. Coleman
Water Resources Commission
3830 Forest Drive
Columbia, SC 29240

STATE APPLICATION IDENTIFIER

Clearinghouse Use Only
CONTROL NUMBER
DIST. NO. FY
09 2001 6

SUSPENSE DATE
10/6

The attached project notification is being referred to your agency in accordance with Office of Management and Budget Circular A-95. This System coordinates the review of proposed Federal or federally assisted development programs and projects. Please provide comments below, relating the proposed project to the plans, policies, and programs of your agency. All comments will be reviewed and compiled by the State Clearinghouse. Any questions may be directed to this office by phone at 758-2946. Please return this form prior to the above suspense date to:

State Clearinghouse
Division of Administration
1205 Pendleton Street
Columbia, South Carolina 29201

Signature: Elmer C. Whitten, Jr.

Name: Elmer C. Whitten, Jr.

RESULTS OF AGENCY REVIEW

- [x] PROJECT CONSISTENT WITH AGENCY PLANS AND POLICIES
- [ ] AGENCY REQUESTS CONFERENCE TO DISCUSS COMMENTS
- [ ] AGENCY COMMENTS ON CONTEMPLATED APPLICATION AS FOLLOWS:

Page 25, last paragraph,
Note correction attached

(Use separate continuation sheets if necessary)

FOR THE REVIEWING AGENCY:
SIGNATURE: F.B. L. Gilbert DATE: 9/19/75
TITLE: Civil Engineer PHONE: 751 3510

DOA Form 7 (4/15/74)

A-20

1. Bacteria. Station 1 had the highest fecal coliform densities found during the October and November study period with counts of 830/100 ml and 460/100 ml, respectively. The lowest densities were found at Station 8 where the respective October and November counts were 26/100 ml and 30/100 ml. There was a general increase in densities downstream from Station 8 with a noticeable increase occurring in the vicinity of Stations 6 and 7. The higher levels at Station 7 were possibly caused by an adjacent housing development. Coliform densities also increased downstream of Station 4 most likely as a result of wastes entering the river from Goose Creek and from the municipal and industrial development downstream. During October, the mean surface coliform density at Station 1 was four times higher at high slack tide than it was at low slack tide. A similar observance was made during November except that densities were only about twice as high at high slack tide. These data suggest a possible upstream movement of wastes on an incoming tide.

2.09.3 Wando River. The water quality of the Wando River is generally good and according to the latest state classifications, it is classified as SB (Waters suitable for bathing and any other usages except shellfishing for market purposes. Suitable also for uses requiring water of lesser quality). The quality of waters in the Wando River system is being studied in detail by the South Carolina Water Resources Commission as part of the Wando River Environmental Quality Study. An interim report on this study was published in April 1973 (Reference 11). The summary and conclusions section of the water quality portion of the above report is presented below. Station locations are shown on Figure 19.

"1. Dissolved oxygen remained fairly high during the sampling period (January, 1973) ranging from a low of 7.7 mg/l to a high of 11.4 mg/l with most of the readings greater than ten. Dissolved oxygen saturation was above 85 percent most of the time. The lowest dissolved oxygen saturation reading during the sampling period was 60 percent and this was coincident with a water temperature of 4°C. The highest DO saturation was recorded as 100%. There is an apparent defect in the lower Wando River as measured by this criterion. Readings are progressively lower from the Cooper River (Station 1) upstream to the head of Hobcaw Creek at Station 4 where the lowest average DO saturation was experienced. Above Hobcaw Creek (Stations 5-8) DO saturation improved dramatically. Five-day Biological Oxygen Demand (BOD) readings ranged from 1.25 mg/l to 5.2 mg/l with an average of 2.68 mg/l. BOD readings were generally higher at the stations nearer the river mouth. In this study BOD was probably about normal considering the range of water temperatures which prevailed. While no rigid standards have been established for water quality based upon oxygen content alone, the net indication from arbitrary criteria for oxygen regimes is that a moderately high water quality exists in the Wando River as compared to other waters in the Charleston harbor environs.

A (1)

than does water. This is the result of the affinity of mercury for muds and soil material together with the otherwise general insolubility of mercurial compounds. In addition, natural sea water contains .3 ug/l of mercury. (H & M, 1959). The presence of mercury does not necessarily imply a point source of pollution.

It is concluded from the results of aqueous sample testing that no critical levels of "heavy" metals occur and that no concern for public health is expressed.

It should be noted that sea water not only contains measurable quantities of the elements discussed as well as others, but that traces of some of these elements are essential to cell growth in some of the plants and animals that are a part of the local ecosystem."

2.09.4 Ashley River. The Ashley River is somewhat turbid and its banks are highly urbanized. According to the latest state classifications, the Ashley River is Class SC and such is not suitable for swimming or the harvesting of oysters for market purposes. Although no recent data are known to be available concerning quality of Ashley River waters, it is believed that considerable improvement in water quality has recently been achieved as a result of newly constructed waste treatment facilities. Prominent among these are the two secondary sewage treatment facilities operated by the St. Andrews Public Service District which handle most of the wastes from the urban area adjacent to the Ashley River. In addition, all sewage discharged into the mouth of the Ashley River from the City of Charleston received primary treatment and chlorination. Current discharge sources along the Ashley River, their approximate daily discharge and type of treatment are presented in Table 10.

2.10 Air Quality. The Charleston County Health Department monitors air quality in the project area. Air quality varies with industrial development, the volume of automobile traffic, and local air circulation patterns. These factors interact in such a way that the highest suspended particulate content is found over parts of peninsular Charleston. The average suspended particulates measured during the period July through September 1973 at a station on the corner of Calhoun Street and Lockwood Drive ranged from 29.48 to 37.66 ug/m^3. Another peninsular station is located on the Queen Street Fire Station, where the geometric mean level of suspended particulates was reported to be 48.1 ug/m^3 during the period November 1972 to March 1973. These levels are well within the Federal standard which is 75 ug/m^3 and the State standard which is 60 ug/m^3.

South Carolina
Project Notification & Review System

Mr. S. [illegible] PROJECT NOTIFICATION REFERRAL

TO: Dept. of HEW
2600 Bull Street
Columbia, SC 29201

STATE APPLICATION IDENTIFIER

Clearinghouse Use Only
CONTROL NUMBER
DIST. NO. FY
4 2 0 0 1 6

SUSPENSE DATE
10/6

The attached project notification is being referred to your agency in accordance with Office of Management and Budget Circular A-95. This System coordinates the review of proposed Federal or federally assisted development programs and projects. Please provide comments below, relating the proposed project to the plans, policies, and programs of your agency. All comments will be reviewed and compiled by the State Clearinghouse. Any questions may be directed to this office by phone at 758-2946. Please return this form prior to the above suspense date to:

State Clearinghouse
Division of Administration
1205 Pendleton Street
Columbia, South Carolina 29201

Signature: Elmer C. Whitten, Jr.

Name Elmer C. Whitten, Jr.

RESULTS OF AGENCY REVIEW

RECEIVED
SEP 24 1975
DIVISION OF
ADMINISTRATION

☐ PROJECT CONSISTENT WITH AGENCY PLANS AND POLICIES

☐ AGENCY REQUESTS CONFERENCE TO DISCUSS COMMENTS

☒ AGENCY COMMENTS ON CONTEMPLATED APPLICATION AS FOLLOWS:

In reviewing the various alternative disposal methods listed, we feel that Plan 5 is the most acceptable for purposes of mosquito control. We must object to any plan which utilizes the disposal areas in and around the harbor for, as you know, this intensifies the mosquito control problems and poses a threat to the health and well being of the citizens of the area as well as creating a financial burden on the affected counties.

L. A. Williams, Jr., Director
Division of Vector Control

(Use separate continuation sheets if necessary)

FOR THE REVIEWING AGENCY:
SIGNATURE: [signature] DATE: 9-23-75

TITLE: Community Affairs PHONE: 758-5537

APPENDIX B

FIGURES AND TABLES

LIST OF FIGURES

LIST OF TABLES

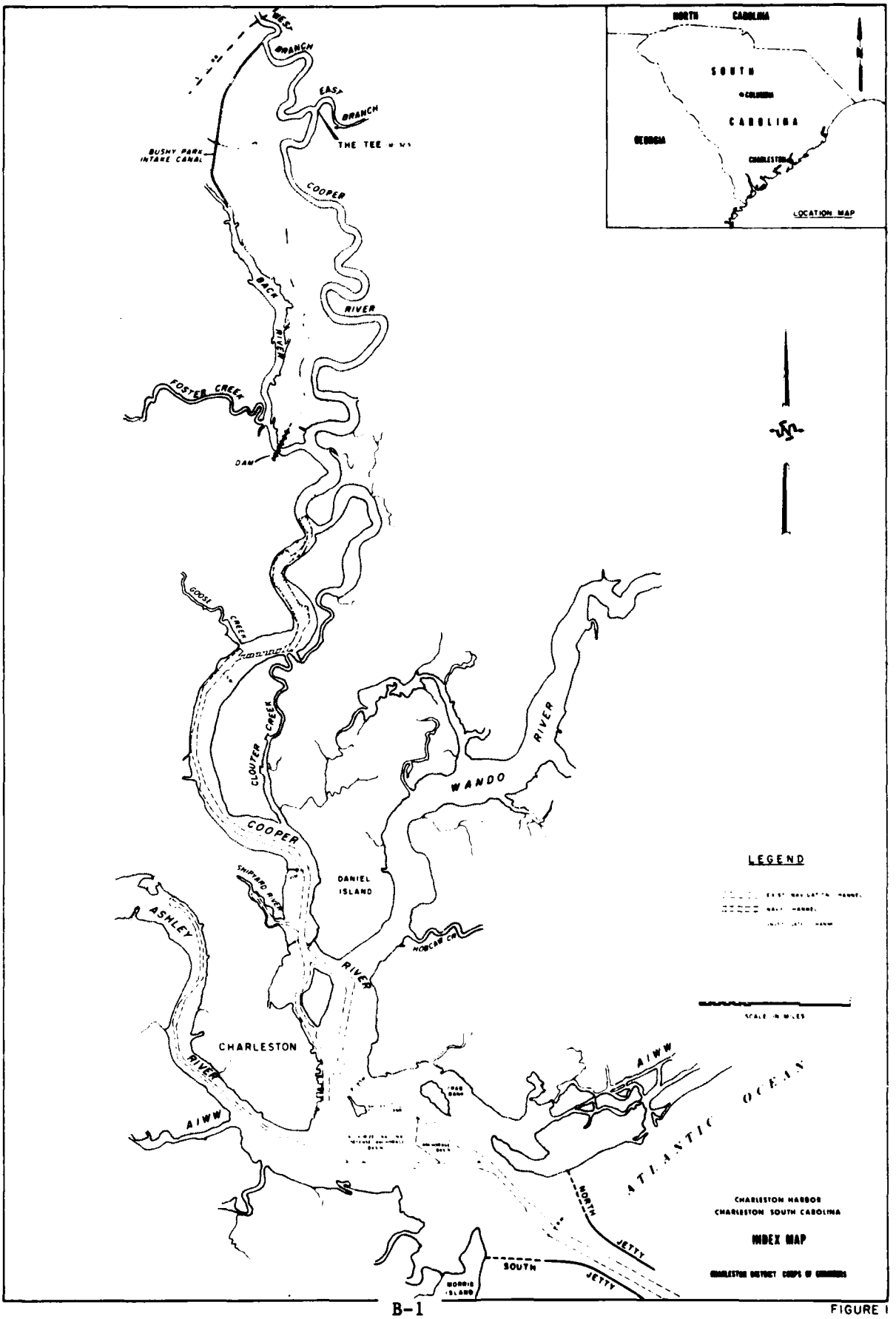

NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
CHARLESTON
LOCATION MAP
WEST BRANCH
EAST BRANCH
THE TEE
BUSHY PARK INTARE CANAL
COOPER
BACK RIVER
FOSTER CREEK
DAM
GOOSE CREEK
CLOUTER CREEK
WANDO RIVER
COOPER
SHIPYARD RIVER
DANIEL ISLAND
ASHLEY
NORTH CHARLESTON
RIVER
CHARLESTON
AIWW
ATLANTIC OCEAN
NORTH JETTY
SOUTH JETTY
MORRIS ISLAND
LEGEND
SCALE IN MILES
CHARLESTON HARBOR
CHARLESTON SOUTH CAROLINA
INDEX MAP

FIGURE 1

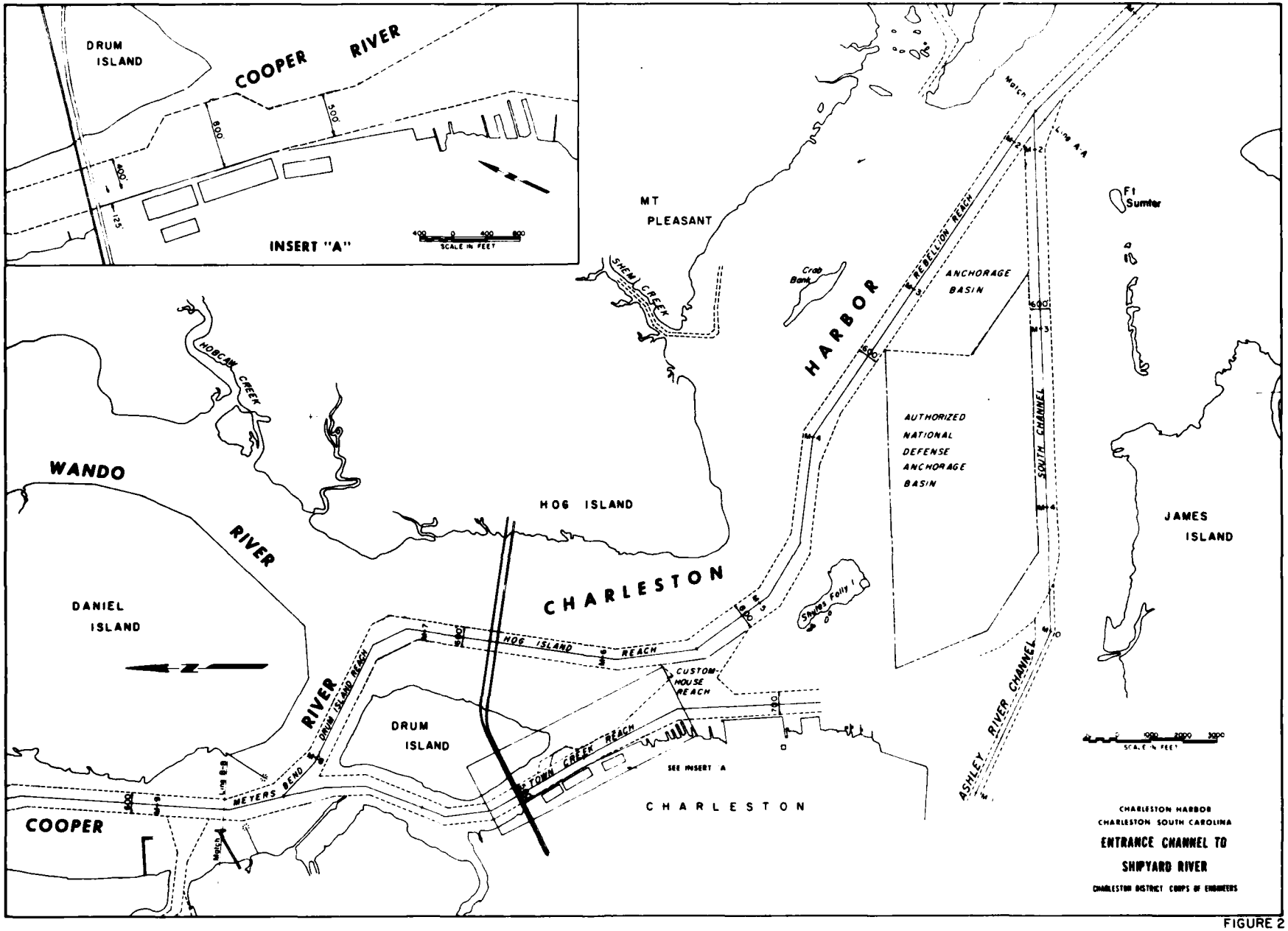

DRUM ISLAND
COOPER RIVER
800
500
400
125
INSERT "A"
SCALE IN FEET
MT PLEASANT
SHEM CREEK
Crab Bank
HARBOR
REBELLION REACH
ANCHORAGE BASIN
Fl Sumter
Mpch
Line A-A
MOBCAW CREEK
WANDO RIVER
HOG ISLAND
AUTHORIZED NATIONAL DEFENSE ANCHORAGE BASIN
SOUTH CHANNEL
JAMES ISLAND
CHARLESTON
DANIEL ISLAND
Shutes Folly I
HOG ISLAND REACH
CUSTOM-HOUSE REACH
DRUM ISLAND REACH
MEYERS BEND
DRUM ISLAND
TOWN CREEK REACH
SEE INSERT A
ASHLEY RIVER CHANNEL
COOPER
CHARLESTON
CHARLESTON HARBOR
CHARLESTON SOUTH CAROLINA
ENTRANCE CHANNEL TO SHIPYARD RIVER
CHARLESTON DISTRICT CORPS OF ENGINEERS

FIGURE 2

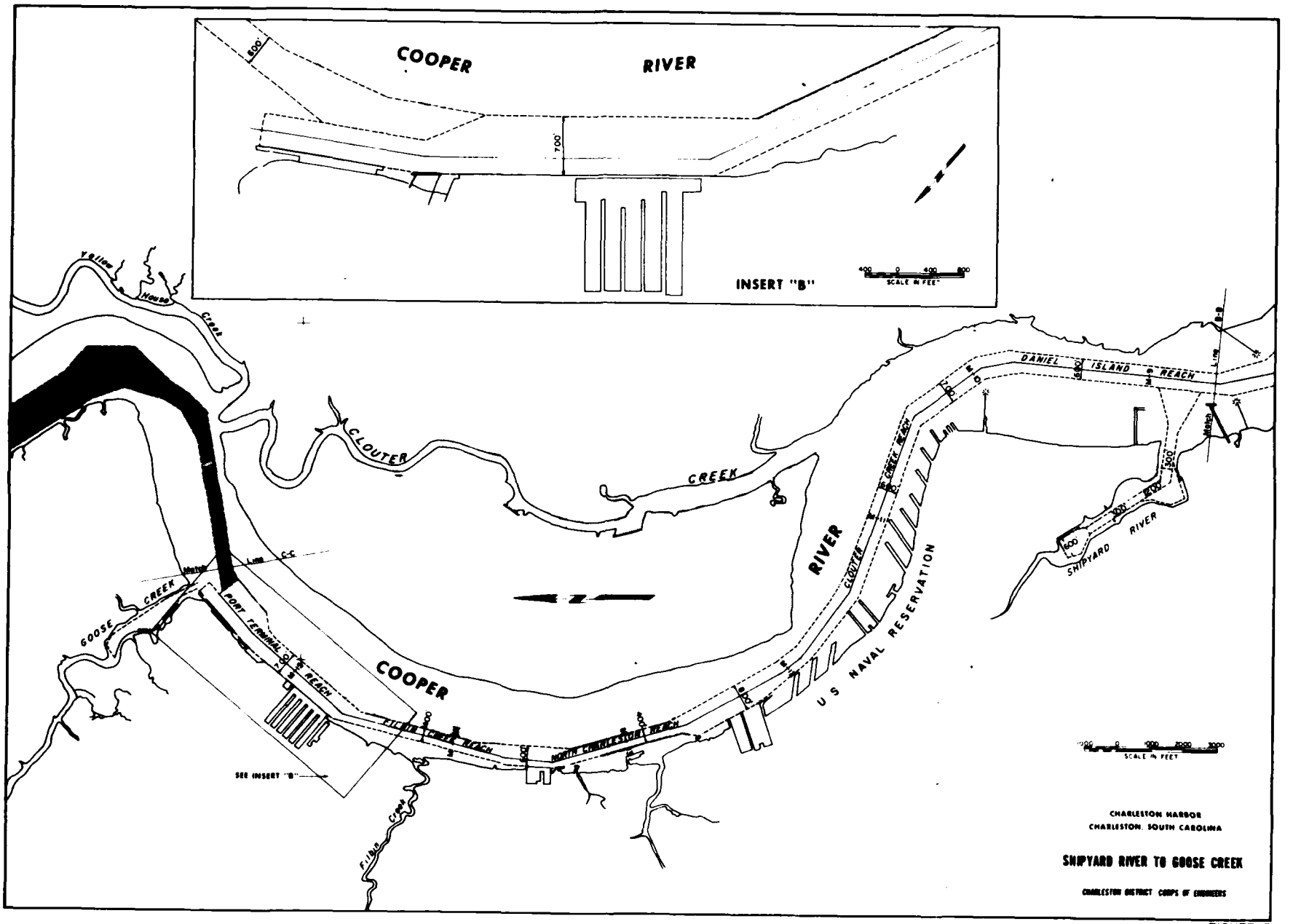

COOPER RIVER
INSERT "B"
SCALE IN FEET
YELLOW HOUSE CREEK
CLOUTER CREEK
GOOSE CREEK
PORT TERMINAL CHANNEL REACH
FILBIN CREEK REACH
NORTH CHARLESTON REACH
DANIEL ISLAND REACH
CLOUTER CREEK REACH
SHIPYARD RIVER
U S NAVAL RESERVATION
SEE INSERT "B"
FILBIN CREEK
CHARLESTON HARBOR
CHARLESTON, SOUTH CAROLINA
SHIPYARD RIVER TO GOOSE CREEK
CHARLESTON DISTRICT, CORPS OF ENGINEERS

FIGURE 3

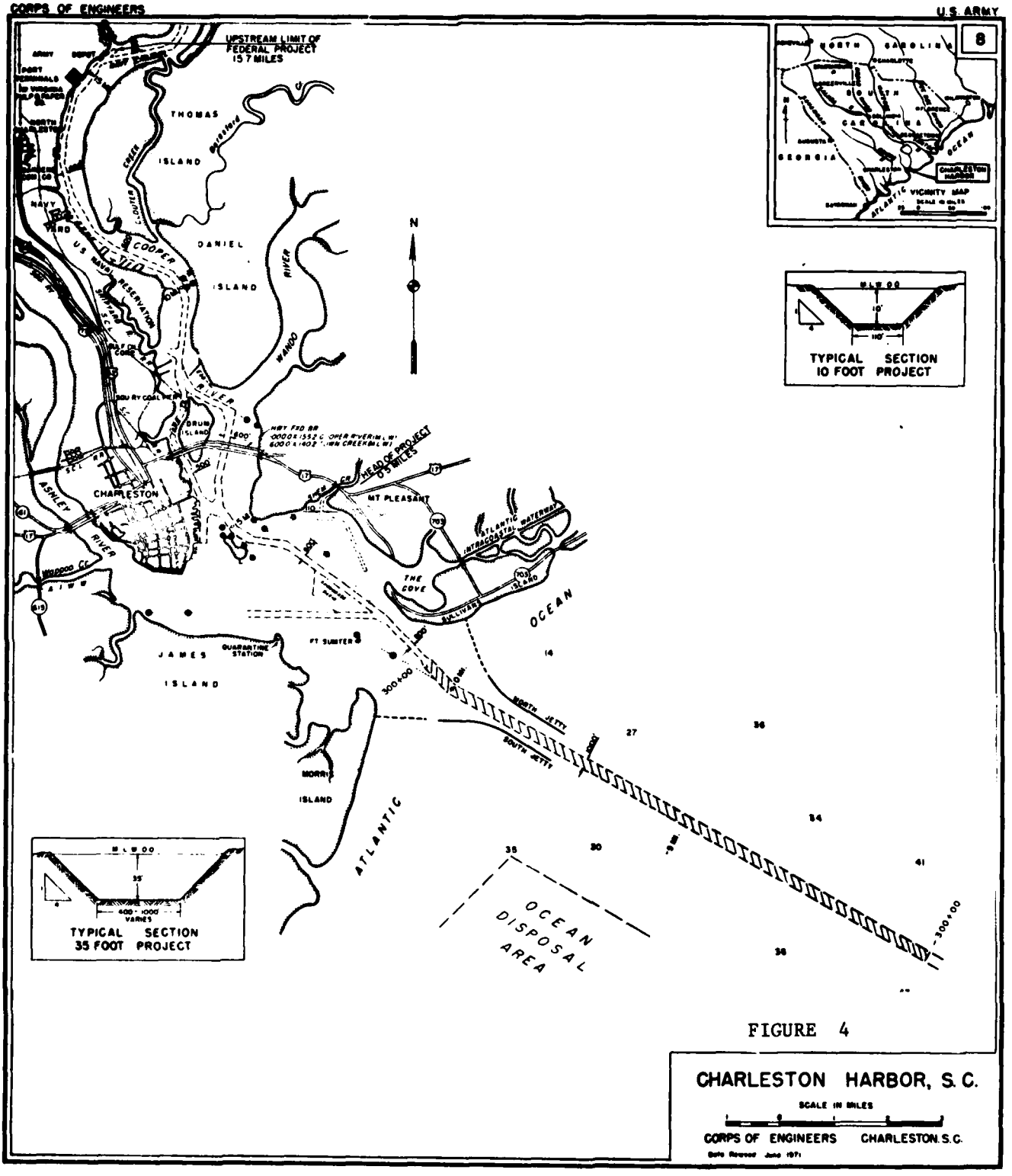

CORPS OF ENGINEERS
U.S. ARMY
UPSTREAM LIMIT OF FEDERAL PROJECT 15.7 MILES
THOMAS ISLAND
DANIEL ISLAND
COOPER RIVER
WANDO RIVER
CHARLESTON
ASHLEY RIVER
MT PLEASANT
HEAD OF PROJECT 0.5 MILES
ATLANTIC INTRACOASTAL WATERWAY
THE COVE
OCEAN
JAMES ISLAND
FT SUMTER
QUARANTINE STATION
MORRIS ISLAND
ATLANTIC
NORTH JETTY
SOUTH JETTY
OCEAN DISPOSAL AREA
N
VICINITY MAP
TYPICAL SECTION 10 FOOT PROJECT
TYPICAL SECTION 35 FOOT PROJECT
CHARLESTON HARBOR, S. C.
SCALE IN MILES
CORPS OF ENGINEERS CHARLESTON, S.C.

FIGURE 4

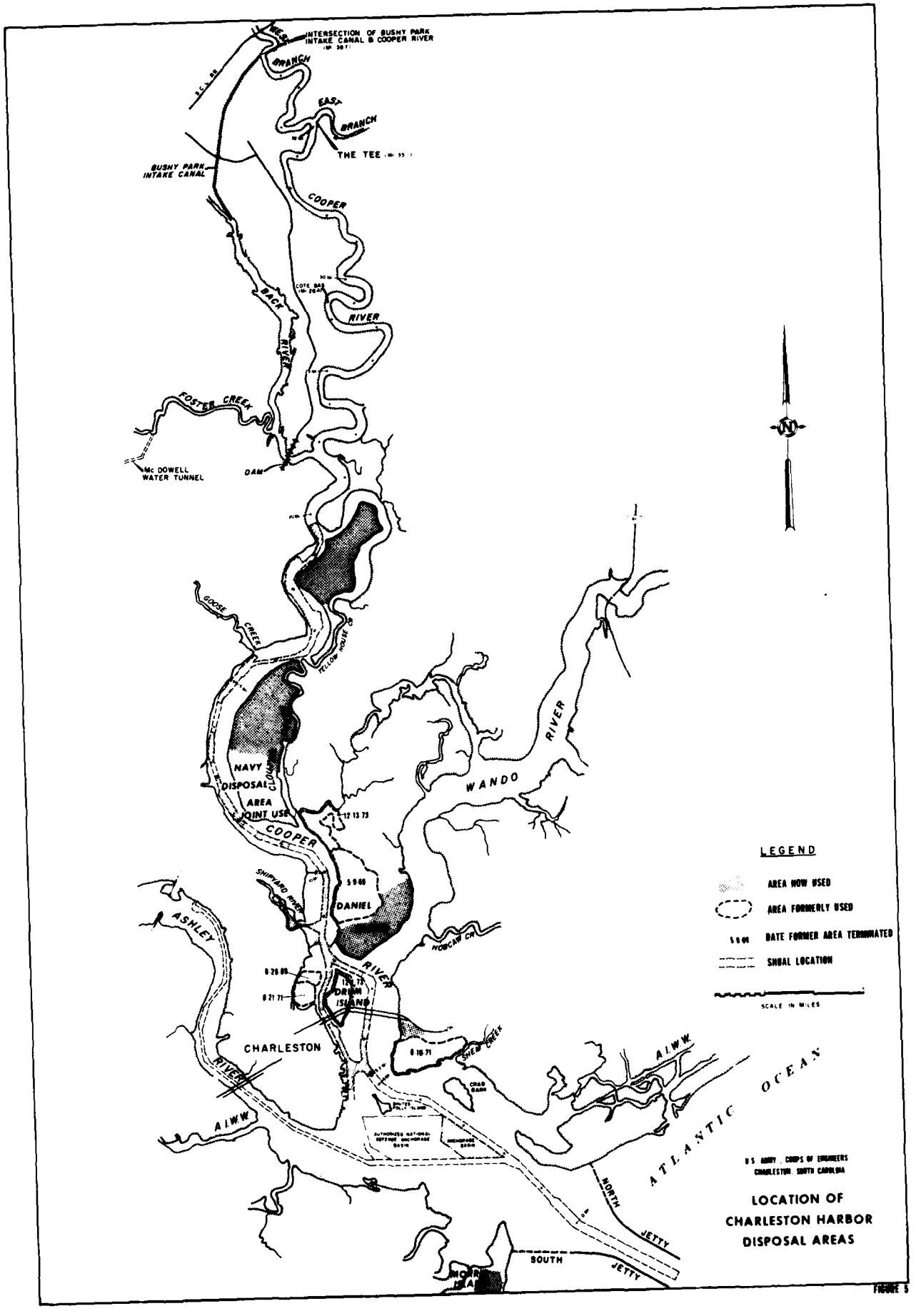

INTERSECTION OF BUSHY PARK INTAKE CANAL & COOPER RIVER
BRANCH
EAST
BRANCH
THE TEE
BUSHY PARK INTAKE CANAL
COOPER
BACK
RIVER
RIVER
FOSTER CREEK
Mc DOWELL WATER TUNNEL
DAM
GOOSE CREEK
YELLOW HOUSE CR
NAVY DISPOSAL AREA JOINT USE
CLOUDS
COOPER
WANDO
RIVER
SHIPYARD RIVER
DANIEL
ISLAND
MORGAN CR
ASHLEY
RIVER
CHARLESTON
SHEM CREEK
CRAB BANK
A I W W
ATLANTIC OCEAN
NORTH JETTY
SOUTH JETTY
LEGEND
AREA NOW USED
AREA FORMERLY USED
DATE FORMER AREA TERMINATED
SHOAL LOCATION
SCALE IN MILES
U S ARMY CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA
LOCATION OF CHARLESTON HARBOR DISPOSAL AREAS

FIGURE 5

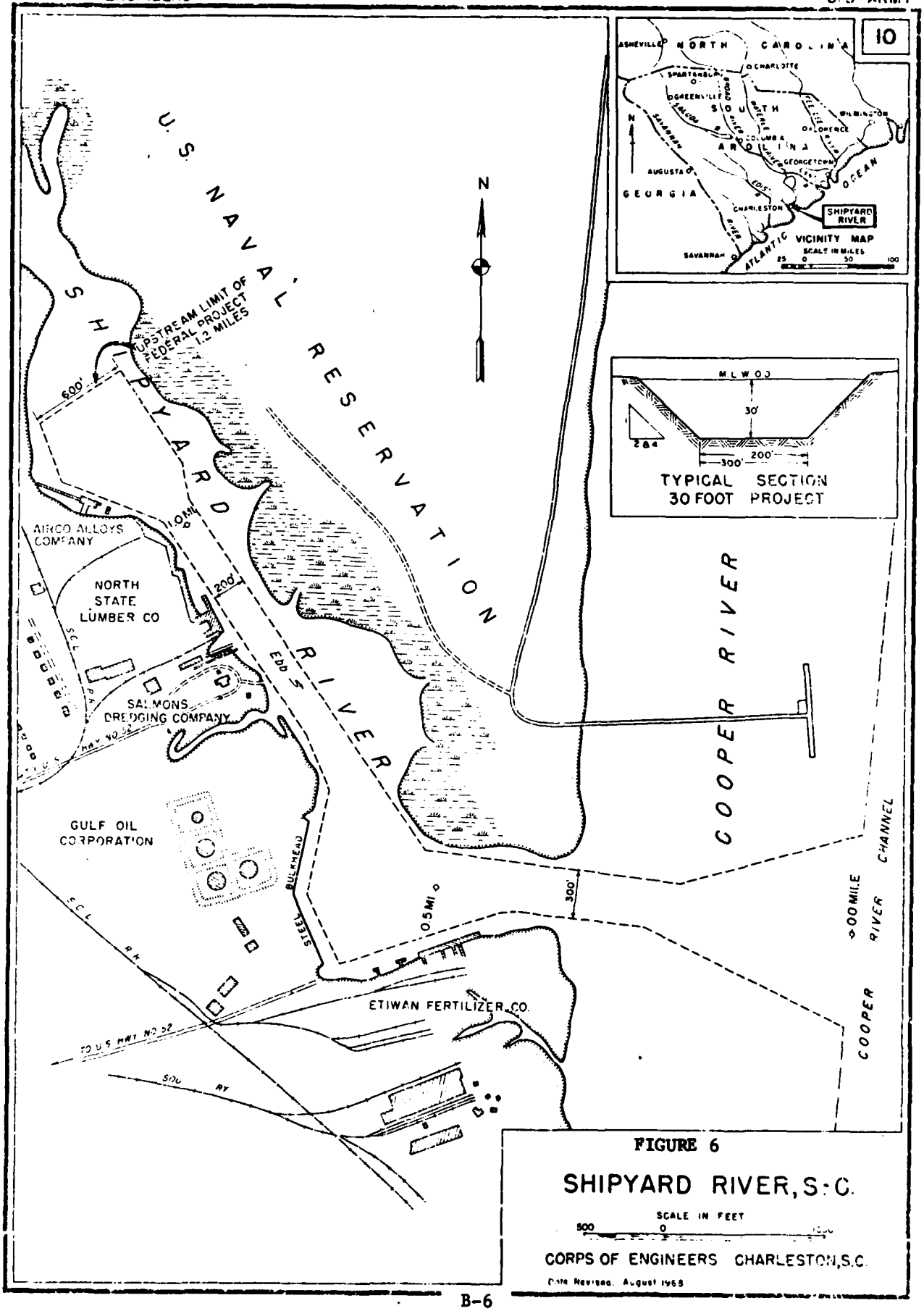


FIGURE 6

SHIPYARD RIVER, S.C.

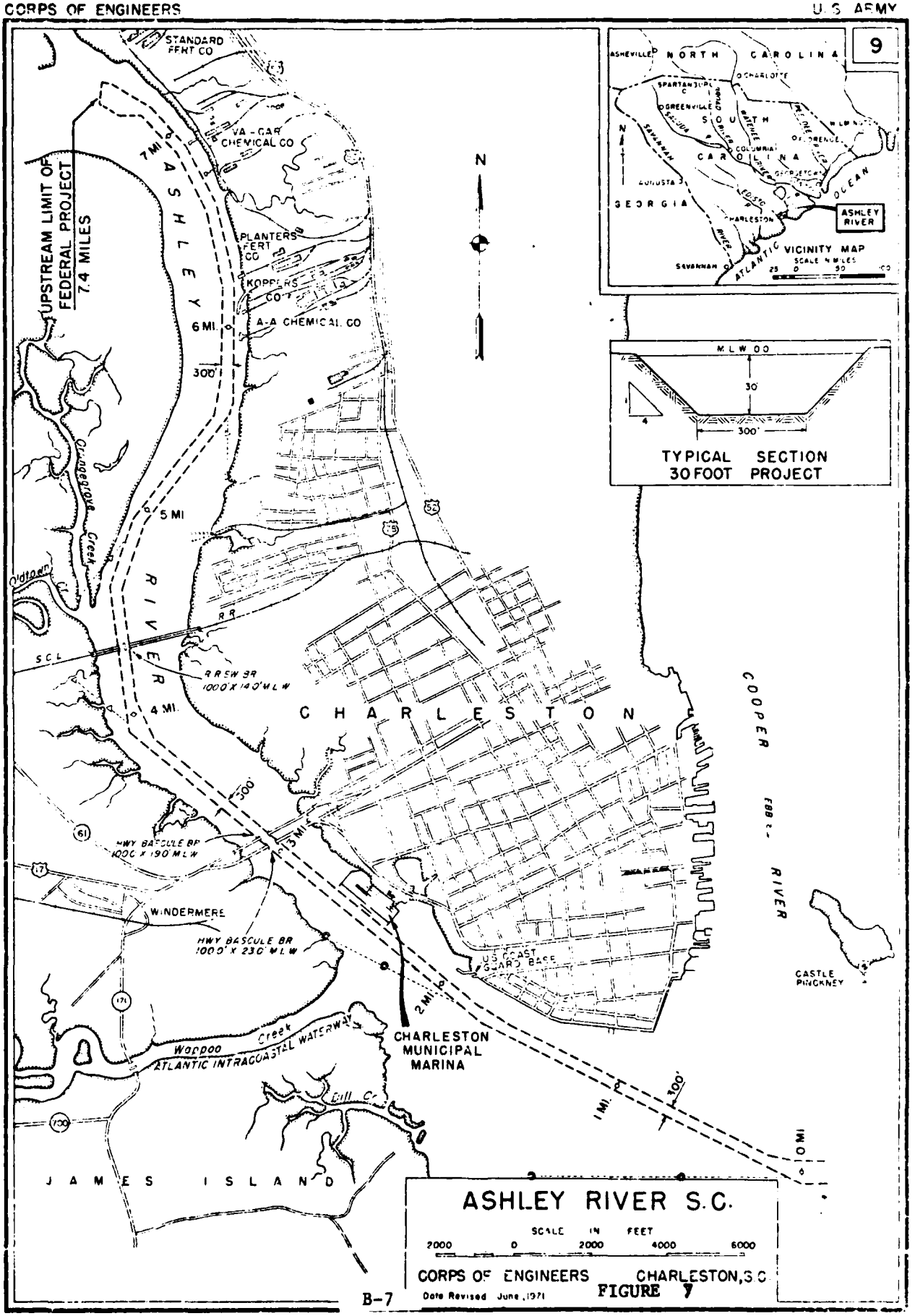
SCALE IN FEET

500 0

CORPS OF ENGINEERS CHARLESTON, S.C.

Date Revised August 1968

CORPS OF ENGINEERS U.S. ARMY



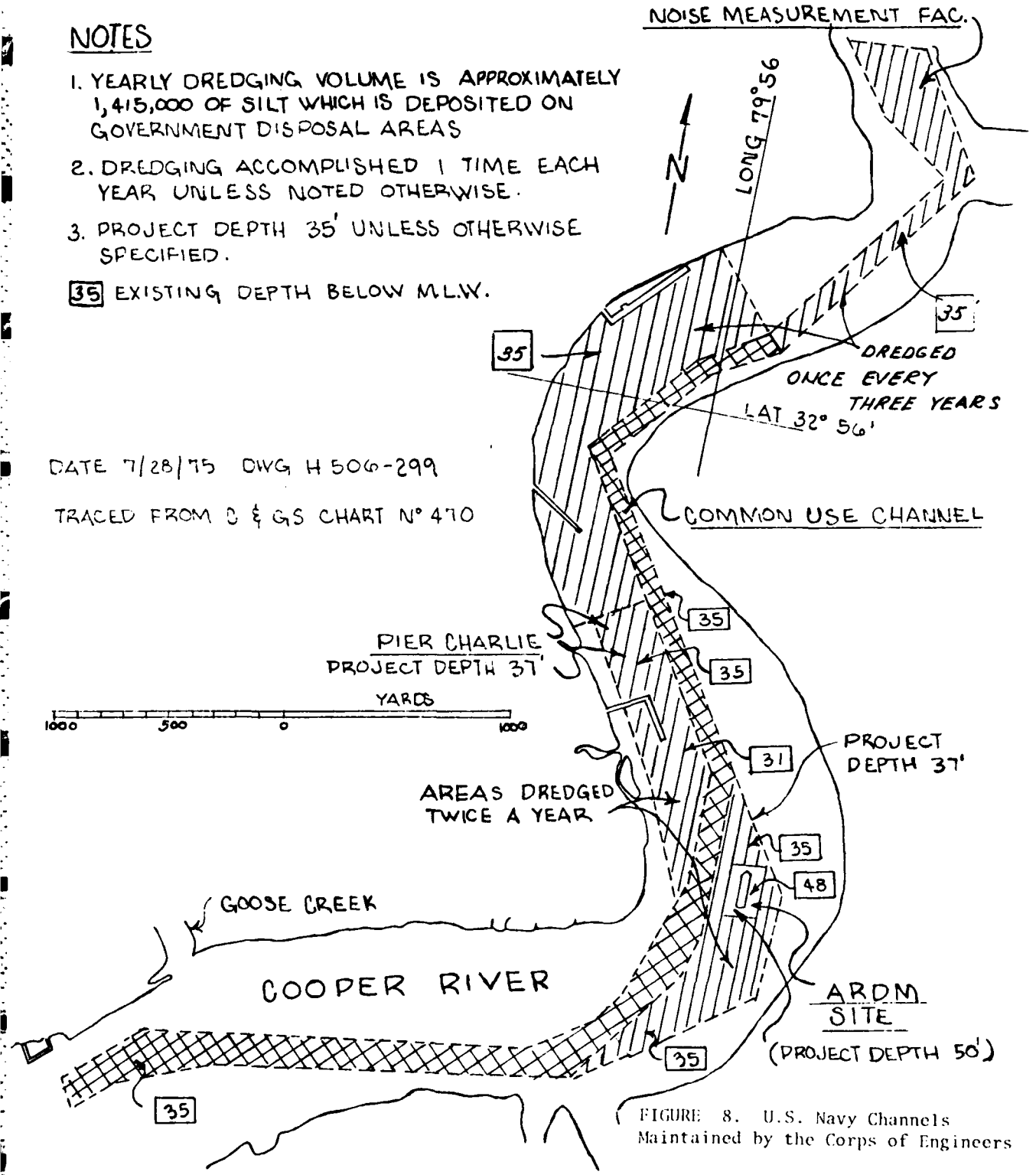
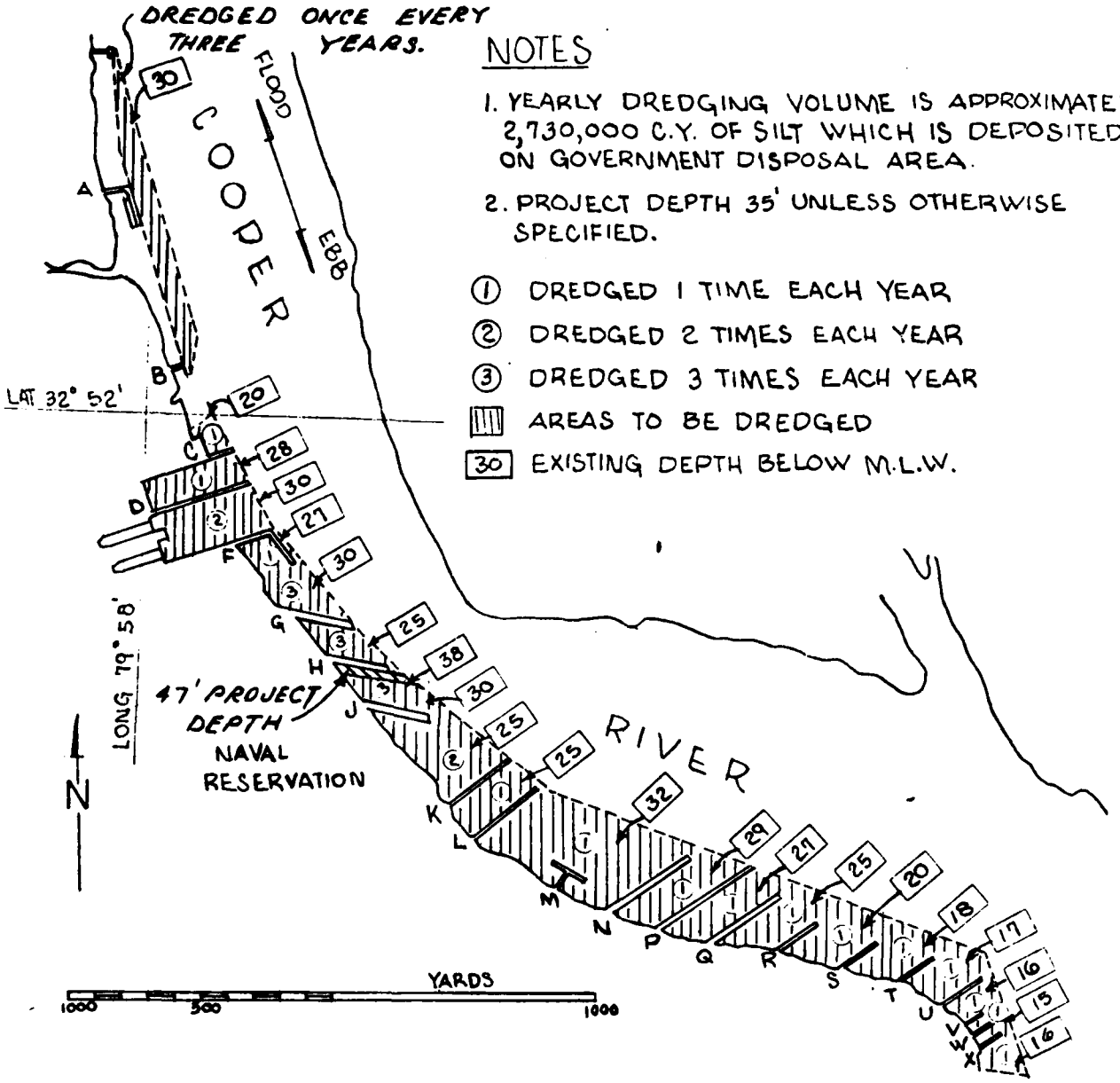


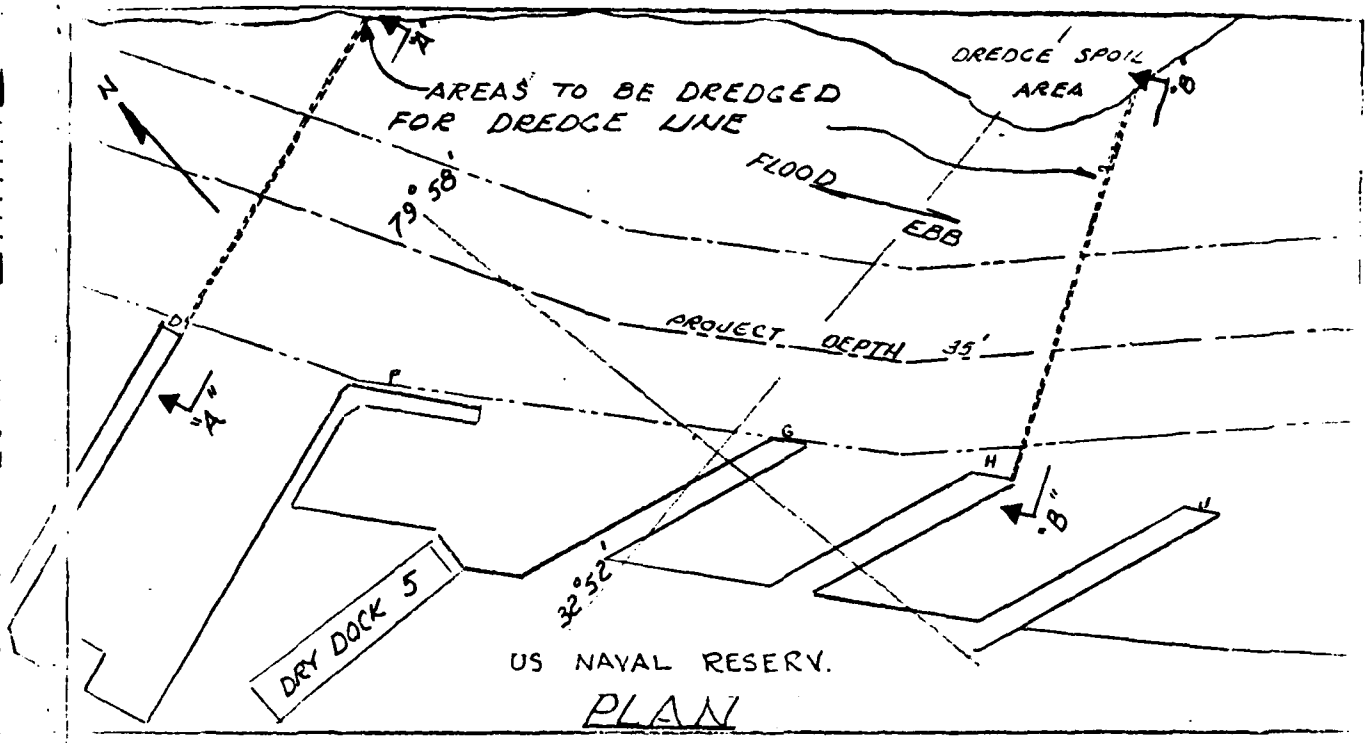
FIGURE 8. U.S. Navy Channels Maintained by the Corps of Engineers

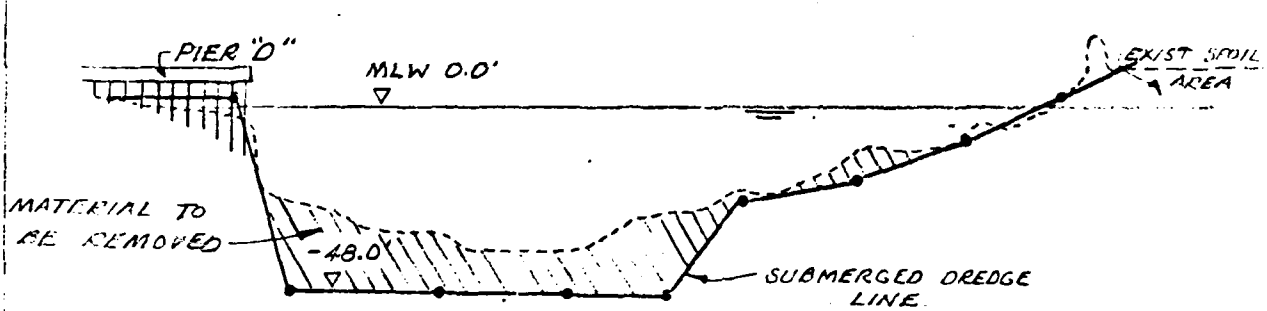


DATE 7/23/75 DWG H 506-299

TRACED FROM C & G.S N° 450

FIGURE 9. U.S. Navy Dredging Around Piers and Slips





SECTION "A-A"
SECTION "B-B" IDENTICAL

1. AREAS ARE DREDGED ONCE EVERY EIGHT YEARS.
2. DREDGING VOLUME IS APPR. 13,000 CY OF SILT WHICH IS DEPOSITED ON GOVERNMENT DISPOSAL AREA

FIGURE 10. U.S. Navy Dredging for Submerged Dredge Line.

DATE 7/28/75 DWG H 506-299

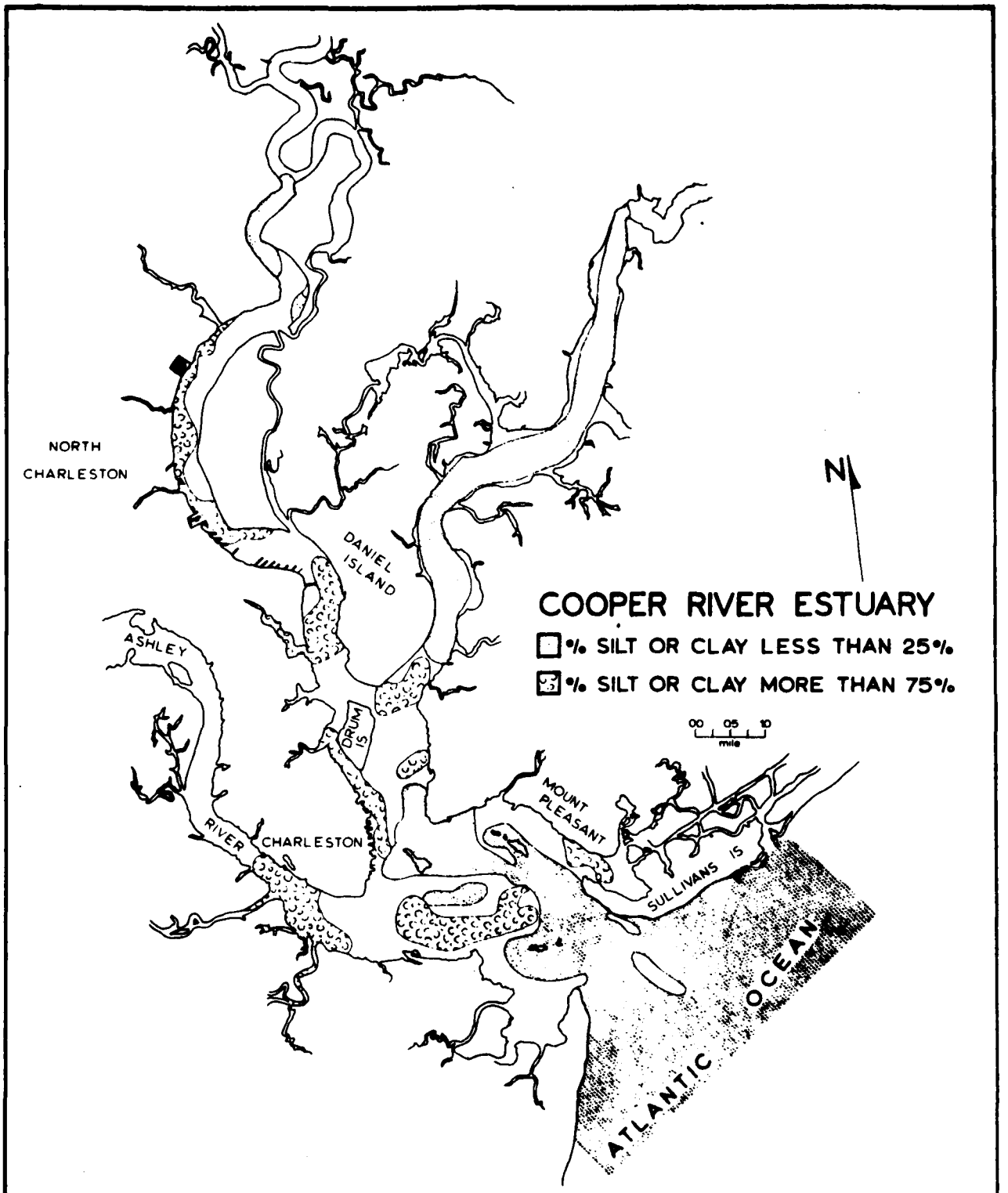


FIGURE 11 PERCENT SILT OR CLAY IN CHARLESTON HARBOR SEDIMENTS

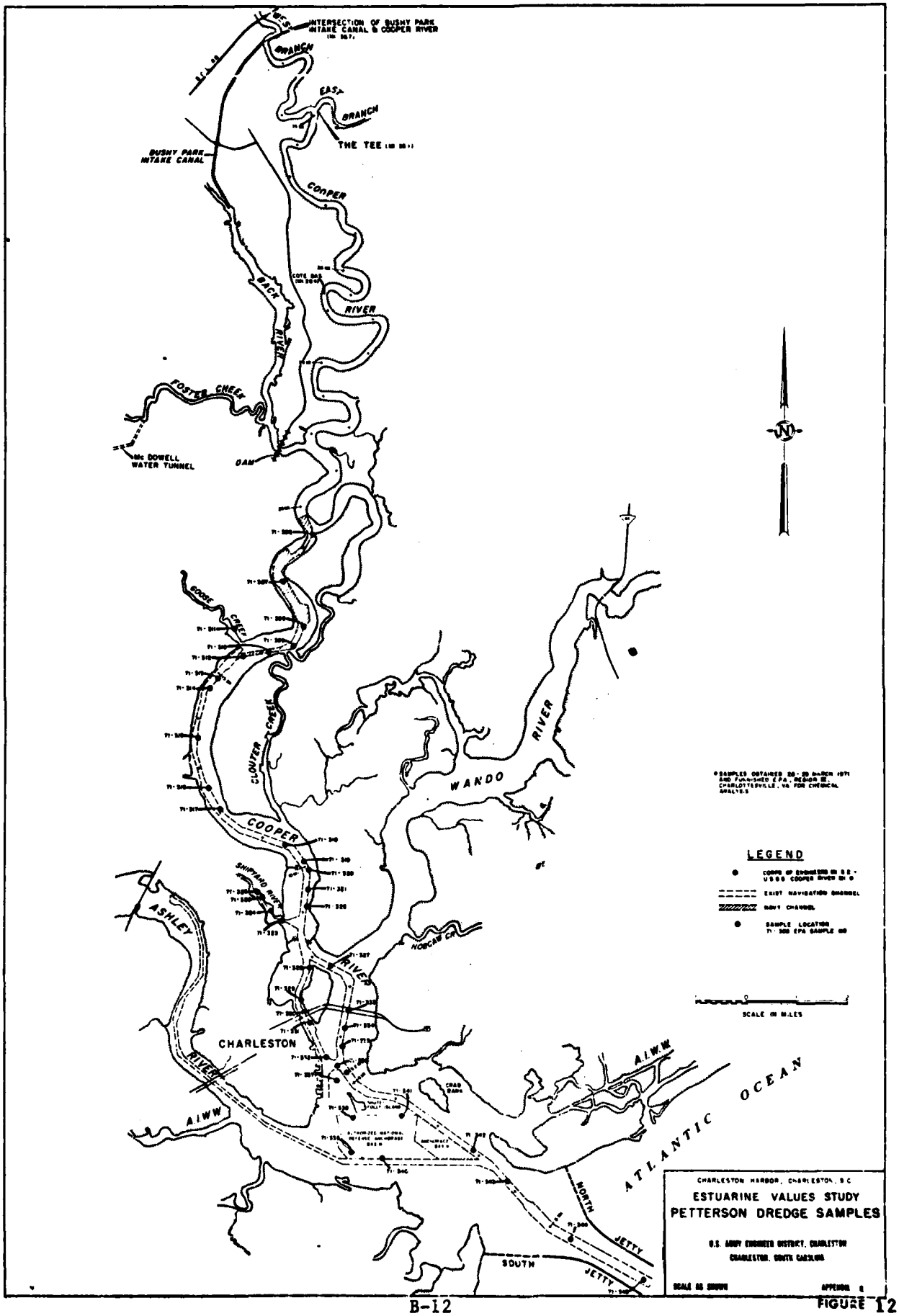
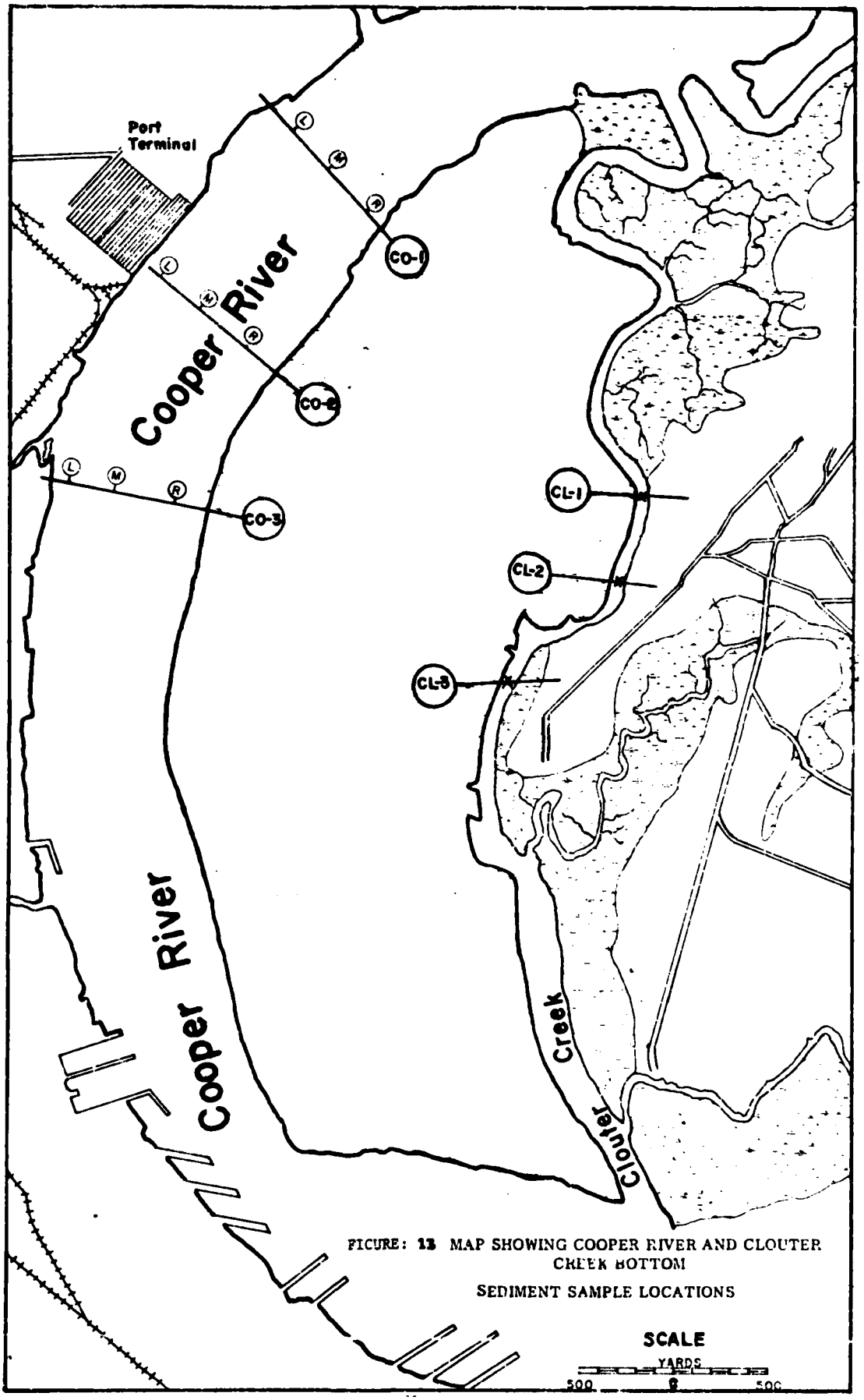

INTERSECTION OF BUSHY PARK INTAKE CANAL & COOPER RIVER
WEST BRANCH
EAST BRANCH
THE TEE
BUSHY PARK INTAKE CANAL
COOPER
BACK RIVER
RIVER
FOSTER CREEK
Mc DOWELL WATER TUNNEL
DAM
GOOSE CREEK
CLOUTER CREEK
WANDO RIVER
COOPER
SHIPYARD RIVER
ASHLEY
HOBCAW CR.
RIVER
CHARLESTON
RIVER
AIWW
AIWW
ATLANTIC OCEAN
NORTH JETTY
SOUTH JETTY
SAMPLES OBTAINED 30 - 31 MARCH 1971 AND FURNISHED EPA, REGION III, CHARLOTTESVILLE, VA. FOR CHEMICAL ANALYSIS
LEGEND
CORPS OF ENGINEERS OR U.S. USGS COOPER RIVER OR O
EXIST NAVIGATION CHANNEL
NAVY CHANNEL
SAMPLE LOCATION
SCALE IN MILES
CHARLESTON HARBOR, CHARLESTON, S.C.
ESTUARINE VALUES STUDY
PETTERSON DREDGE SAMPLES
U.S. ARMY ENGINEER DISTRICT, CHARLESTON
CHARLESTON, SOUTH CAROLINA
SCALE AS SHOWN
APPENDIX B

FIGURE 12



FICURE: 13 MAP SHOWING COOPER RIVER AND CLOUTER CREEK BOTTOM

SEDIMENT SAMPLE LOCATIONS

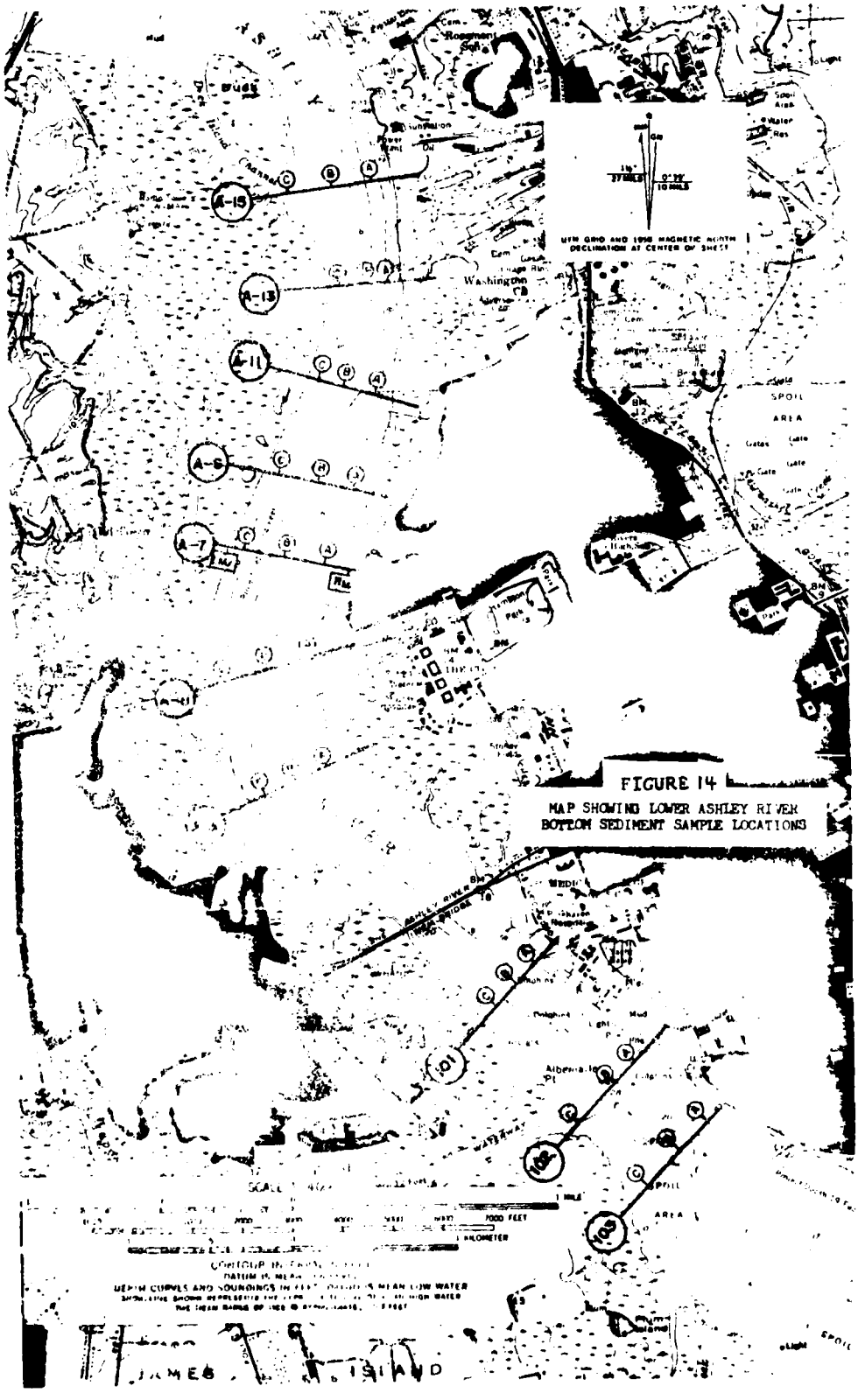


FIGURE 14

MAP SHOWING LOWER ASHLEY RIVER
BOTTOM SEDIMENT SAMPLE LOCATIONS

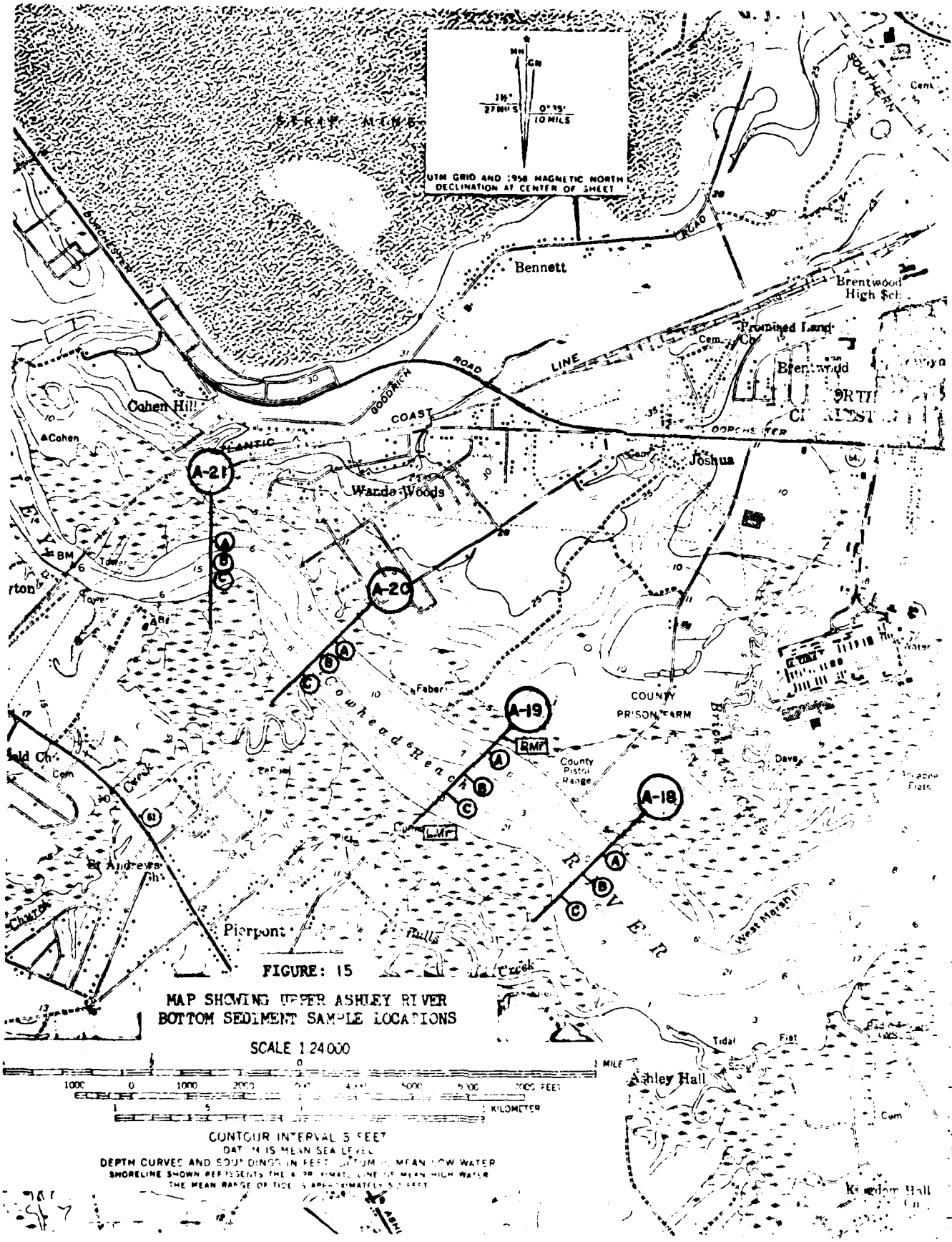


FIGURE: 15

MAP SHOWING UPPER ASHLEY RIVER
BOTTOM SEDIMENT SAMPLE LOCATIONS

SCALE 1:24000

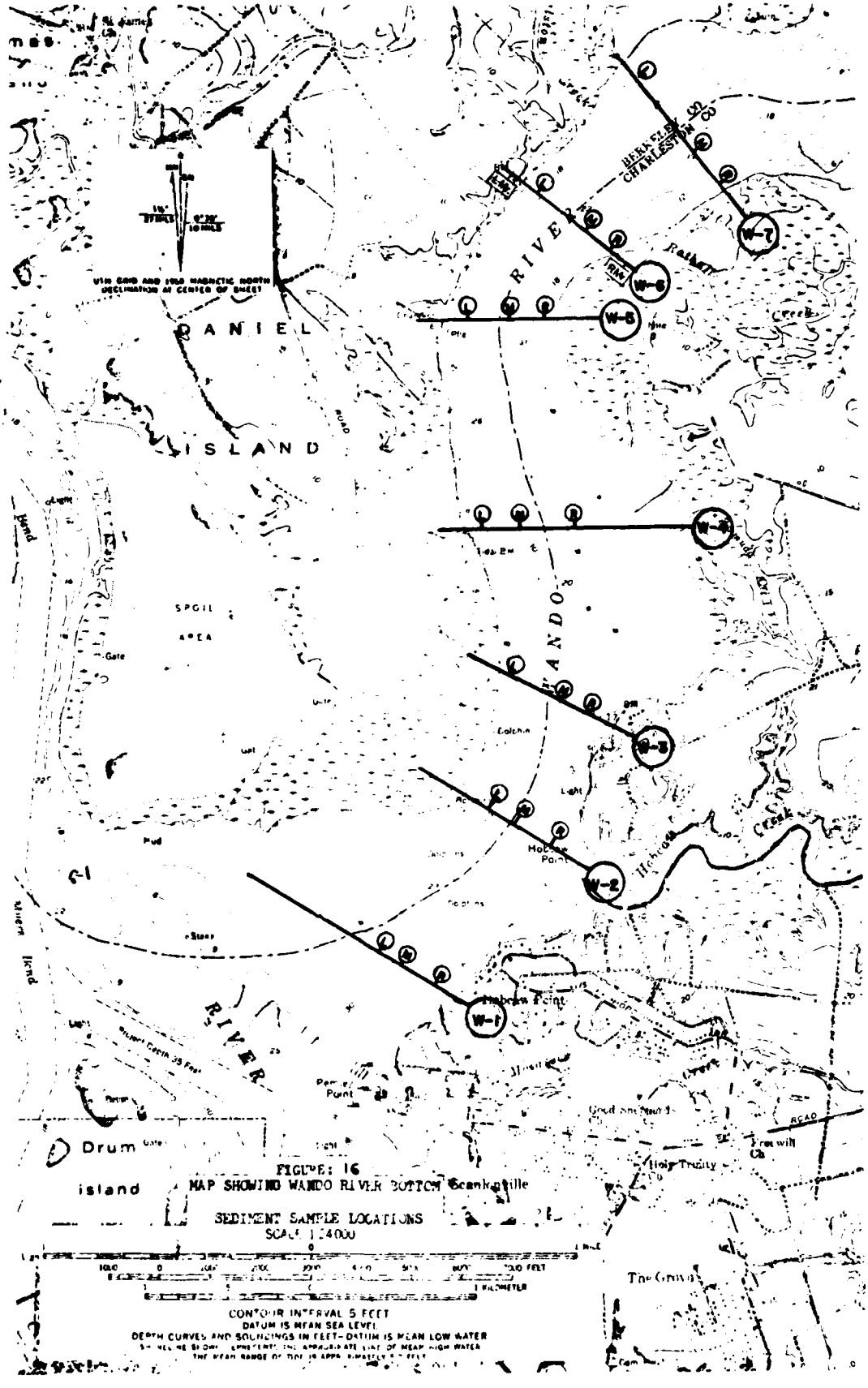


FIGURE: 16
MAP SHOWING WANDO RIVER BOTTOM Sanketille
SEDIMENT SAMPLE LOCATIONS
SCALE 1:24000

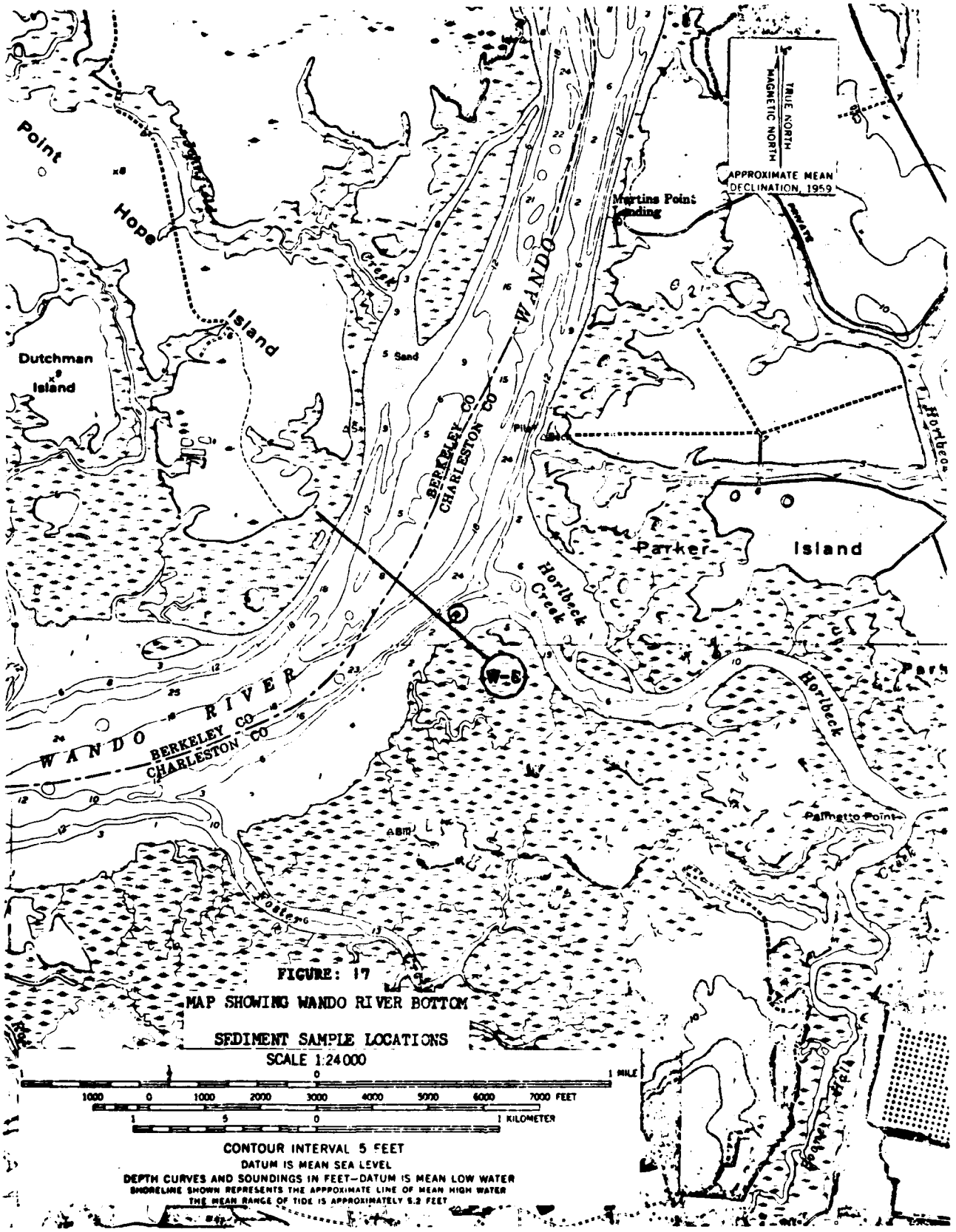


FIGURE: 17

MAP SHOWING WANDO RIVER BOTTOM

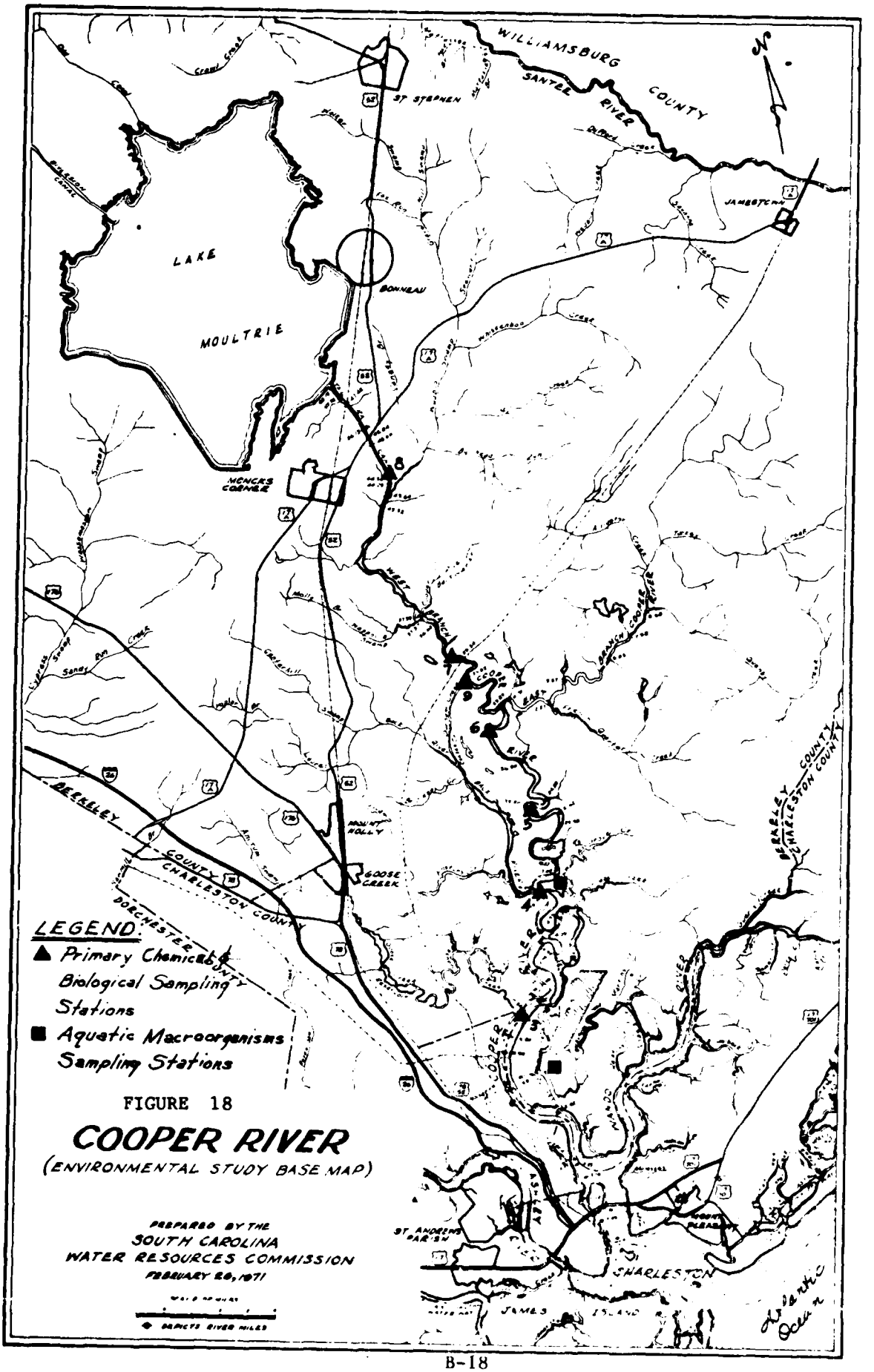


FIGURE 18

COOPER RIVER

(ENVIRONMENTAL STUDY BASE MAP)

PREPARED BY THE
SOUTH CAROLINA
WATER RESOURCES COMMISSION
FEBRUARY 20, 1971

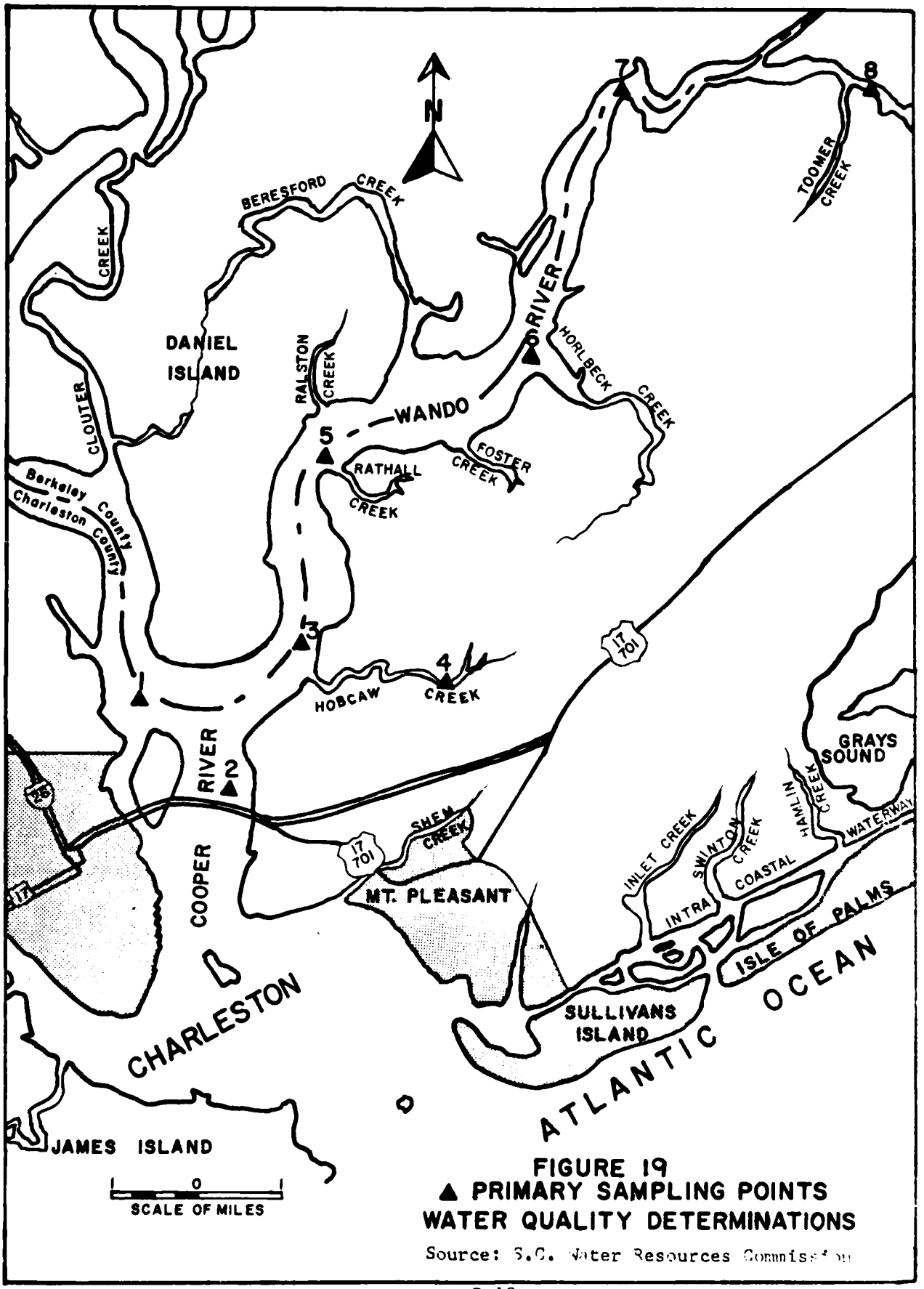
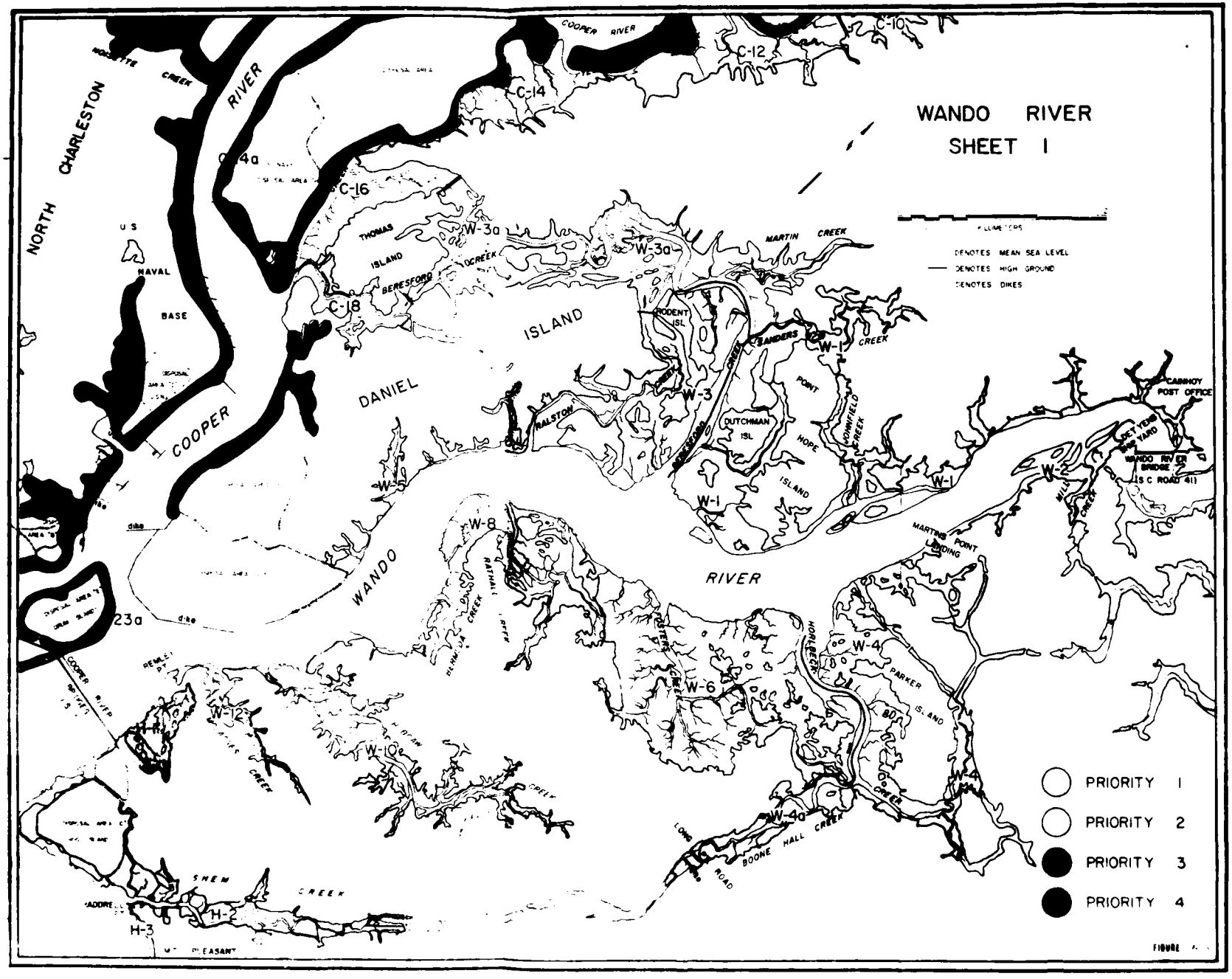
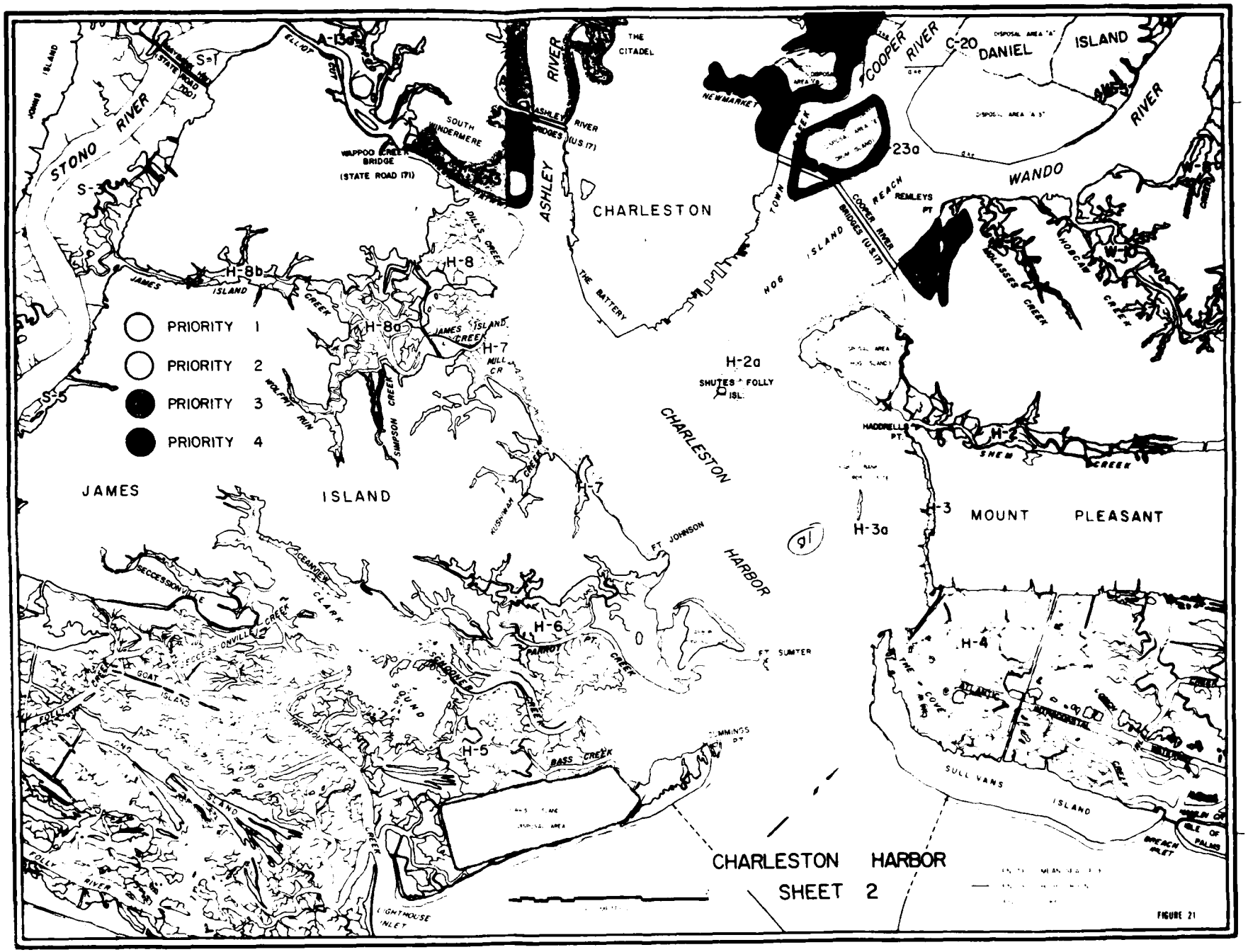


FIGURE 19
▲ PRIMARY SAMPLING POINTS
WATER QUALITY DETERMINATIONS

Source: S.C. Water Resources Commission



REPRODUCED AT GOVERNMENT EXPENSE


PRIORITY 1
PRIORITY 2
PRIORITY 3
PRIORITY 4
CHARLESTON HARBOR
SHEET 2
JAMES ISLAND
CHARLESTON
MOUNT PLEASANT
SULLIVANS ISLAND
STONO RIVER
ASHLEY RIVER
COOPER RIVER
WANDO RIVER
CHARLESTON HARBOR
H-1
H-2
H-2a
H-3
H-3a
H-4
H-5
H-6
H-7
H-8
H-8a
H-8b
23a
C-20
DANIEL ISLAND
THE CITADEL
SHUTES FOLLY ISL.
FT SUMTER
FT JOHNSON
SOUTH WINDERMERE
WAPPOO CREEK BRIDGE (STATE ROAD 171)
ELLIOTT CUT
NEWMARKET
TOWN CREEK
COOPER RIVER BRIDGES (U.S.17)
REMLEYS PT
HOG ISLAND
THE BATTERY
DILLS CREEK
JAMES ISLAND CREEK
WOLFPIT RUN
SIMPSON CREEK
MILL CR
KUSHWAH CREEK
HADDRELLS PT
SHEM CREEK
MOLASSES CREEK
WHOOPING CREEK
OCEANVIEW
CLARK
SECESSIONVILLE
ONVILLE
CREEK
FOLLY
GOAT ISLAND
LIGHTHOUSE INLET
SHUBOLEE CREEK
PARROT CREEK
BASS CREEK
CUMMINGS PT
ATLANTIC
SUMMERSTON
BREACH INLET
FIGURE 21

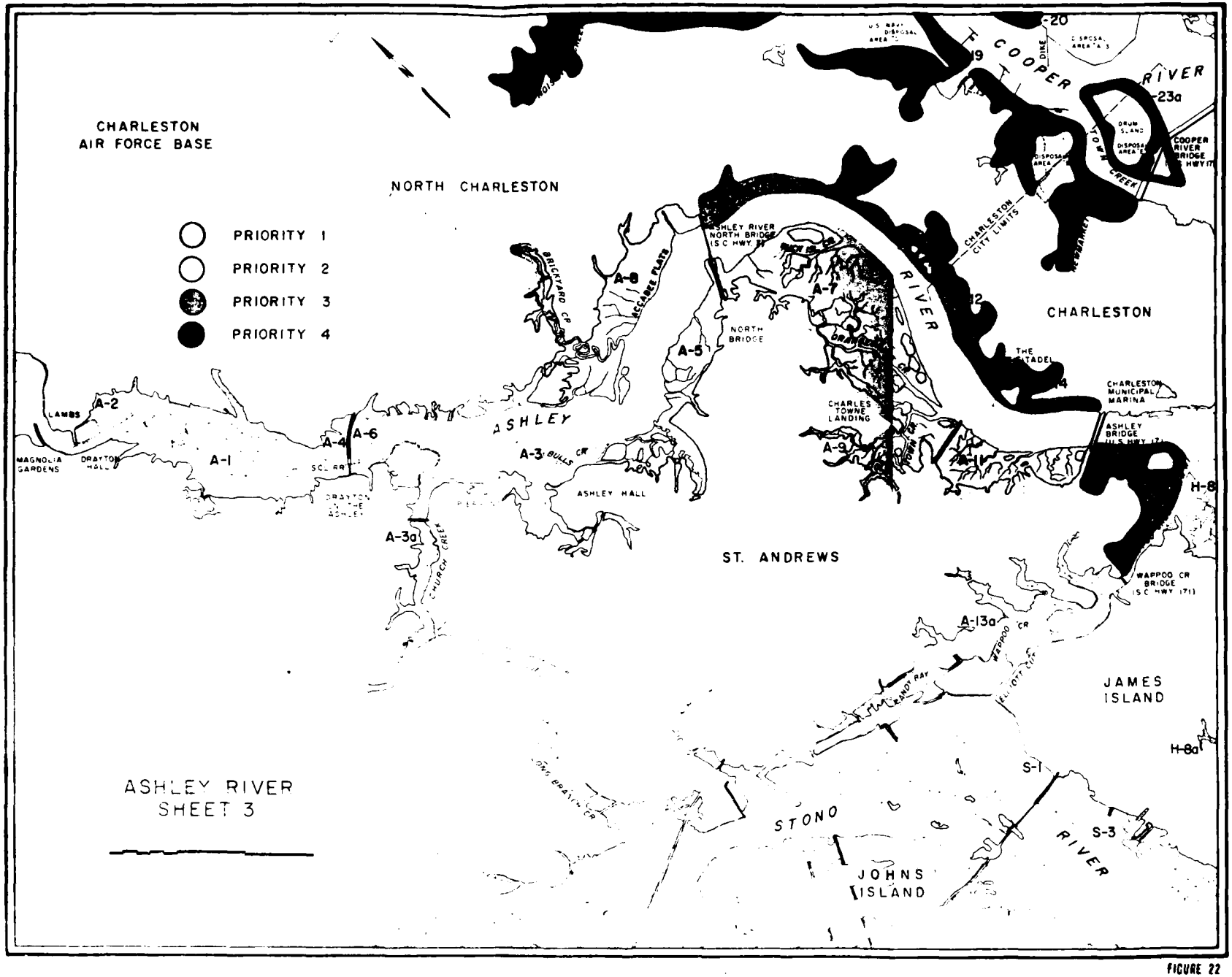

CHARLESTON
AIR FORCE BASE
NORTH CHARLESTON
PRIORITY 1
PRIORITY 2
PRIORITY 3
PRIORITY 4
COOPER RIVER
CHARLESTON
CHARLESTON CITY LIMITS
ASHLEY RIVER NORTH BRIDGE (S C HWY 61)
NORTH BRIDGE
ASHLEY
ASHLEY HALL
ST. ANDREWS
CHARLES TOWNE LANDING
CHARLESTON MUNICIPAL MARINA
ASHLEY BRIDGE (U S HWY 17)
WAPPOO CR BRIDGE (S C HWY 171)
JAMES ISLAND
JOHNS ISLAND
STONO
STONO RIVER
BRICKYARD CR
CHURCH CREEK
WAPPOO CR
SCHOOL CR
LAMBS
MAGNOLIA GARDENS
DRAYTON HALL
A-1
A-2
A-3
A-3a
A-4
A-5
A-6
A-7
A-8
A-9
A-11
A-13a
H-8
H-8a
S-1
S-3
ASHLEY RIVER
SHEET 3

FIGURE 22

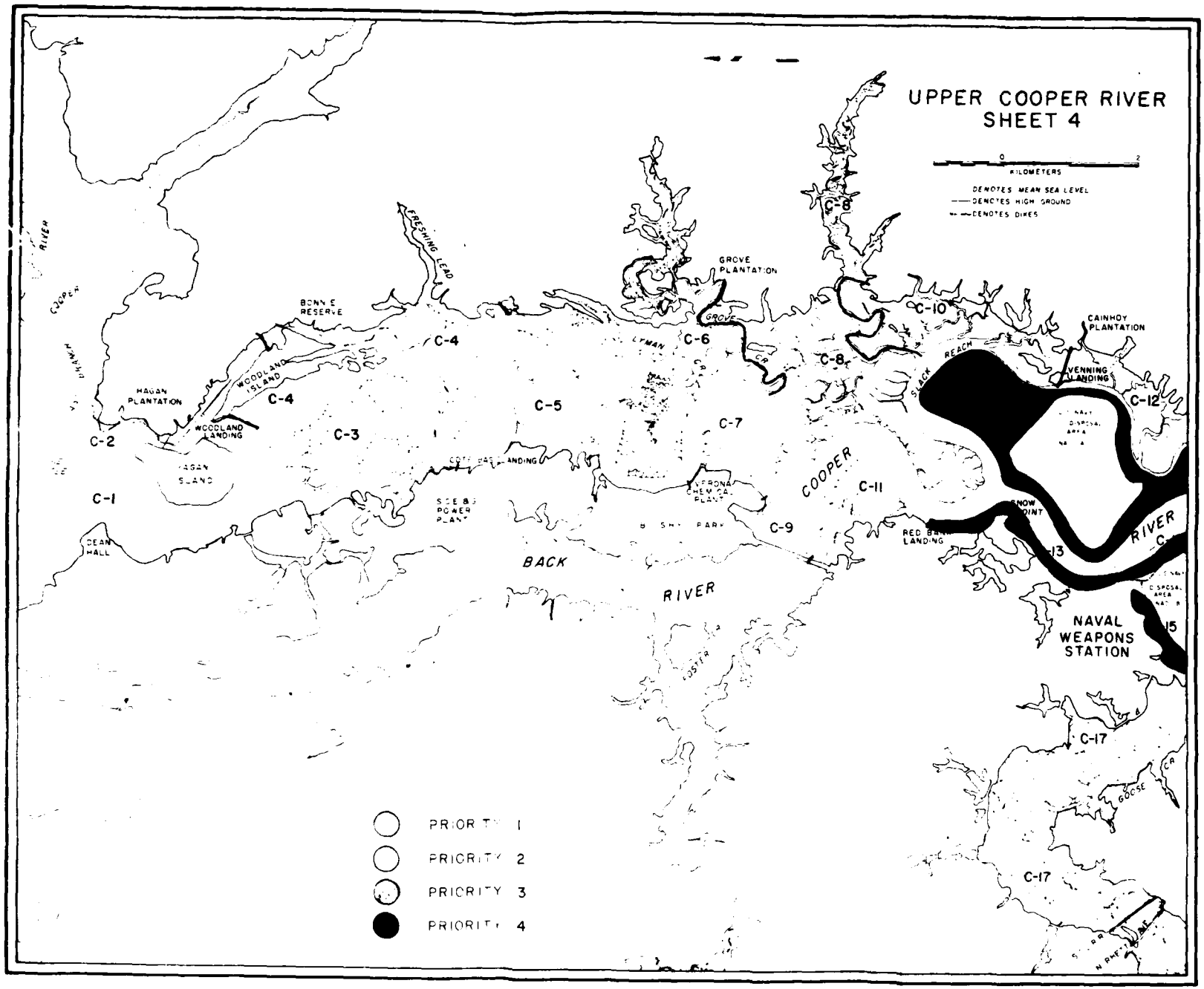


FIGURE 23

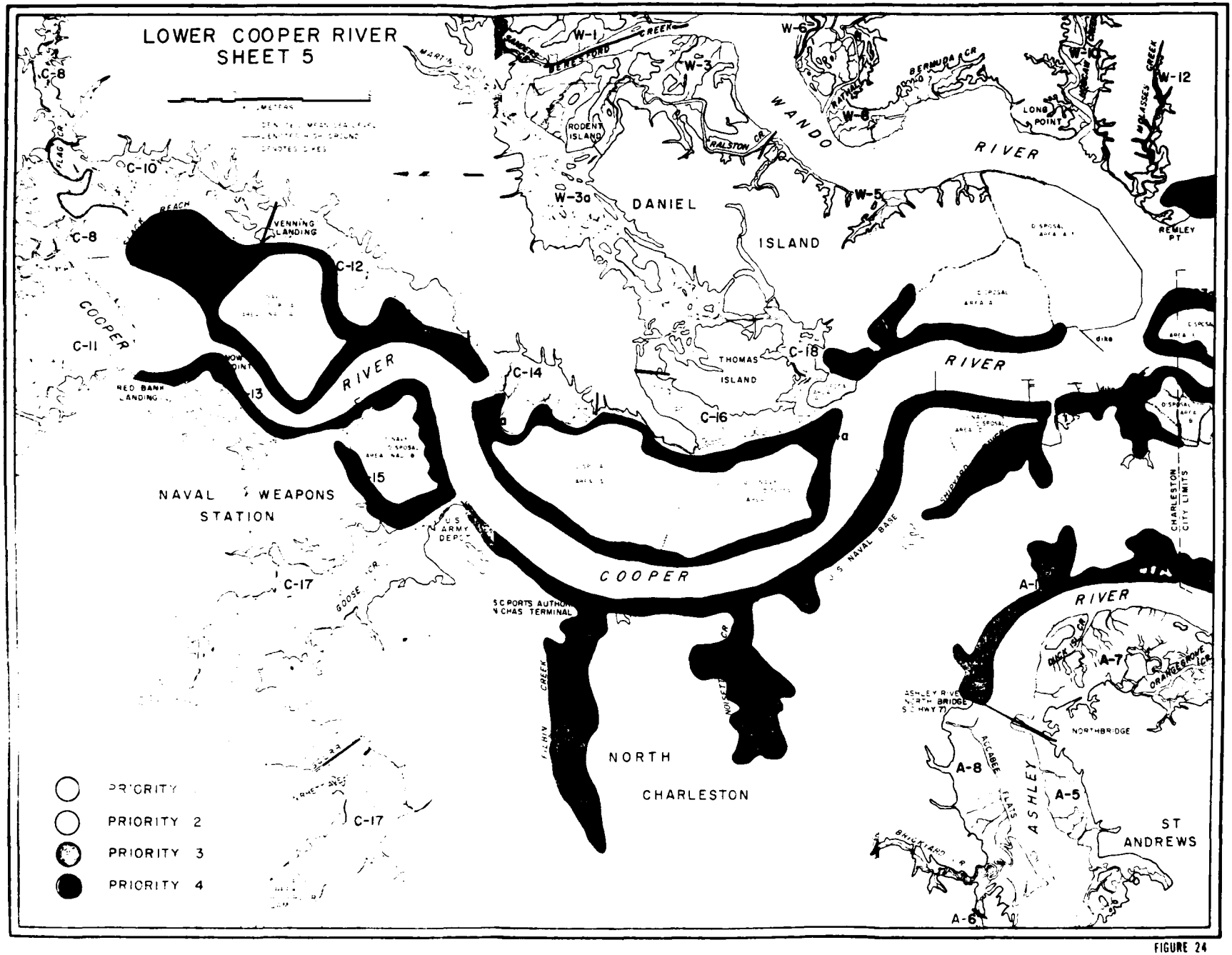

LOWER COOPER RIVER
SHEET 5
METERS
W-1
W-3
W-3a
W-5
W-6
W-8
W-10
W-12
RODENT ISLAND
RALSTON CR
BERMUDA CR
LONG POINT
WANDO
RIVER
DANIEL
ISLAND
REMLEY PT
C-8
C-10
C-11
C-12
C-13
C-14
C-15
C-16
C-17
C-18
FLAG CR
VENNING LANDING
RED BANK LANDING
COOPER
RIVER
THOMAS ISLAND
NAVAL WEAPONS STATION
U S ARMY DEPT
GOOSE CR
SC PORTS AUTHORITY CHAS TERMINAL
U S NAVAL BASE
SHIPYARD
CHARLESTON CITY LIMITS
NORTH CHARLESTON
FILBIN CREEK
NOISETTE CR
A-1
A-5
A-6
A-7
A-8
ASHLEY
RIVER
ORANGEBURG CR
NORTHBRIDGE
ASHLEY RIVER NORTH BRIDGE S C HWY 7
ACCABEE
BACKLAND
FLATS
ST ANDREWS
PRIORITY 1
PRIORITY 2
PRIORITY 3
PRIORITY 4

FIGURE 24

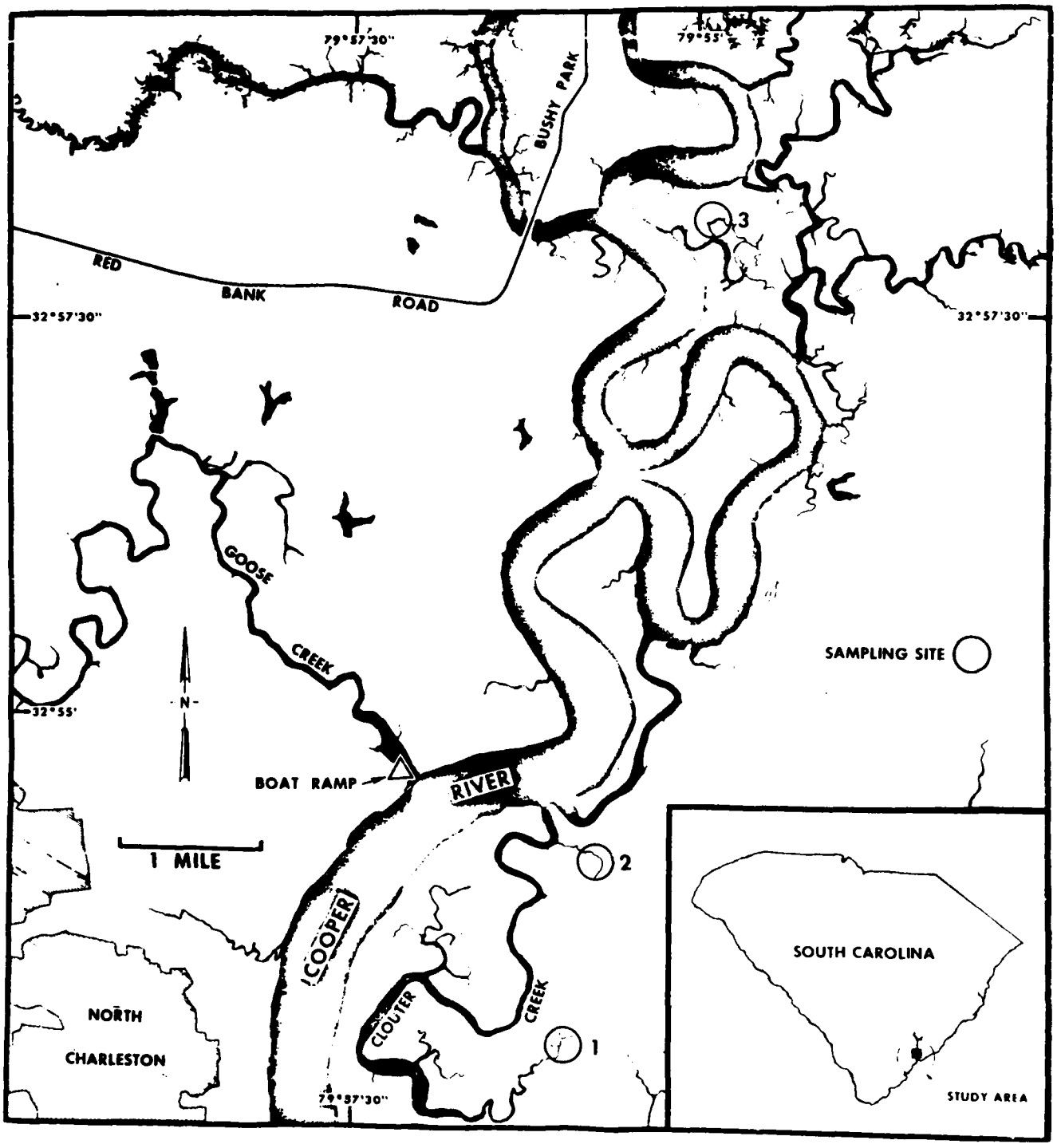


FIGURE 25. SAMPLING STATIONS - COOPER RIVER STANDING CROP STUDIES

Table 1

Summary of Maintenance Dredging
Activities in Charleston Harbor, South Carolina

Shoal Areas	Type	Estimated Quantity (cu. yds.)	Dredging Frequency	Diked Disposal Area	Type Dredge	Depth (feet)
Anchorage Basin	Silt & Sand	650,000	Annually	Morris Island	Pipeline	30
Lower Charleston Harbor	Silt	1,700,000	Annually	Daniel Island	Pipeline	35
Shipyard River	Silt	500,000	Annually	Daniel Island	Pipeline	30
Upper Charleston Harbor	Silt	700,000	Annually	Clouter Creek	Pipeline	35
U. S. Navy Channel	Silt	1,400,000	Annually	Clouter Creek & Yellow House Cr.	Pipeline	35
U. S. Navy Piers & Slips	Silt	2,730,000	Annually	Clouter Creek	Pipeline	20 - 35
S. C. State Ports Auth- and Local Industry	Silt	91,000	Annually	Daniel Island & Drum Island	Pipeline	35
Entrance Channel	Sand & Silt	1,250,000	Annually	Ocean Disposal Area	Hopper Dredge	35
Total		9,021,000				

TABLE 2
ESTIMATES OF ANNUAL DREDGING RATES FOR AVERAGE FRESH-WATER INFLOWS OF 15,600 CFS AND 3,000 CFS

Shoal Reach	Expected Dredging Rate 15,600 cfs	3,000 cfs
Noise Measurement Facility	120,000	37,000
Naval Ammunition Depot Channel	840,000	250,000
Goose Creek	36,000	17,000
Charleston Harbor:		
Shoals 1 & 2	414,020	39,370
Shoal 3	78,240	7,440
Shoal 4	221,680	21,080
Shoal 5	74,980	7,130
Shoal 5A	736,760	70,060
Shoal 6	117,360	11,160
Shoal 6A	638,960	60,760
Shoal 6B	71,720	6,820
Shoal 6C	534,640	50,840
Customhouse Reach	143,440	13,640
Tidewater Reach	228,200	21,700
Navy Slips and Docks	3,000,000	1,220,000
Shipyard River	790,000	370,000
Other Slips and Docks	130,000	53,000
Shem Creek	2,000	1,000
Anchorage Basin	720,000	210,000
Entrance Channel	1,250,000	500,000
Total	10,148,000	2,968,000

Source: Reference 36

Table 3

Charleston Harbor Sediments Analysis Data Collected by the Environmental Protection Agency

Lab No.	Station No.	Date Sampled	Radio-act. pCi/gm	% Tot. Vol. Solids	COD %	TKN %	NH_3-N %	Oil & Grease %	Total P %	Pb %	Zn %	Cu %	Cr %	Morphos %	DEF %	Hg %
71-306	NMF-1	3-30-71		6.9	7.9	0.09	0.004	0.715	0.74	0.0042	0.0075	0.0087	0.0052			<0.00003
71-307	NAD-1	3-30-71		4.2	2.0	0.02	0.001	0.903	0.08	0.0017	0.0059	0.0052	0.0029			
71-308	NAD-2	3-30-71		17	18	0.35	0.020	0.542	0.24	0.0058	0.0135	0.0031	0.0096			
71-309	NAD-3	3-30-71		9.8	10	0.19		0.698	0.25	0.0023	0.0153	0.0027	0.0055			
71-310	NAD-4	3-30-71		8.5	3.6	0.01		0.442	0.93	0.0029	0.0061	0.0022	0.0052			
71-311	GC-1	3-30-71		5.4	7.2	0.09		0.737	0.15	0.0009	0.0069	0.0014	0.0019			
71-312	S12-1	3-30-71		17	18	0.31		0.717	0.05	0.0033	0.0145	0.0048	0.0079			
71-313	S12-2	3-30-71		12	8.1	0.16		0.283	0.18	0.0031	0.0091	0.0034	0.0066			
71-314	S12-3	3-30-71		13	12	0.23		0.156	0.18	0.0054	0.0186	0.0059	0.0081			
71-315	S3-1	3-30-71	<0.2	13	13	0.20		0.598	0.28	0.0041	0.0125	0.0052	0.0060			
71-316	S4-1	3-30-71	<0.2	17	14	0.35		0.518	0.22	0.0044	0.0155	0.0060	0.0088			
71-317	S4-2	3-30-71	<0.2	3.9	3.6	0.04		0.124	0.42	0.0061	0.0280	0.0047	0.0084			
71-318	S5-1	3-30-71	<0.2	5.4	5.5	0.07		0.121	0.37	0.0036	0.0115	0.0022	0.0031			
71-319	S5A-1	3-30-71	<0.2	6.2	2.9	0.11		0.0695	2.2	0.0029	0.0059	0.0034	0.0034			
71-320	S5A-2	3-30-71	<0.2	11	4.3	0.07		0.0718	1.0	0.0033	0.0081	0.0050	0.0070			
71-321	S5A-3	3-30-71		16	12	0.23		0.260	0.28	0.0034	0.0126	0.0050	0.0097			
71-322	S5A-4	3-30-71		15	11	0.28	0.020	0.313	0.23	0.0033	0.0094	0.0042	0.0084			
71-323	SR-1	3-30-71	<0.2	18	12	0.34		0.234	0.12	0.0038	0.0114	0.0048	0.0092			
71-324	SR-2	3-30-71	<0.2	18	14	0.38		0.285	0.13	0.0055	0.0128	0.0042	0.0290			
71-325	SR-3	3-30-72		18	12	0.38		0.0422	0.15	0.0015	0.0150	0.0044	0.0071			
71-326	SR-4	3-30-71	<0.2	17	13	0.40		0.107	0.16	0.0074	0.0170	0.0043	0.0074			
71-327	S6-1	3-31-71	<0.2	7.4	5.4	0.10		0.0942	0.30	0.0026	0.0053	0.0018	0.0038			0.00033
71-328	S6B-1	3-30-71		4.6	1.4	0.03		0.0193	0.45	0.0010	0.0022	0.0016	0.0017			<0.00003
71-329	S6A-1	3-30-71	<0.2	8.4	11	0.23		0.0897	0.21	0.0041	0.0083	0.0015	0.0067			
71-330	S6A-2	3-30-71		7.8	3.4	0.08		0.0655	0.44	0.0028	0.0240	0.0042	0.0035			
71-331	S6A-3	3-30-71		8.1	4.2	0.12		0.0626	0.27	0.0016	0.0047	0.0012	0.0019			
71-332	S6A-4	3-30-71		18	12	0.38		0.136	0.08	0.0045	0.0170	0.0033	0.0056			
71-333	S6C-1	3-31-71		6.7	3.8	0.10		0.0746	0.37	0.0015	0.0048	0.0016	0.0034			
71-334	S6C-2	3-31-71		7.5	3.6	0.12		0.0540	0.18	0.0011	0.0071	0.0013	0.0037			
71-335	S6C-3	3-31-71		1.8	0.5	0.02		0.00739	0.37	0.0006	0.0013	0.0007	0.0011			
71-336	CHR-1	3-31-71	<0.2	11	8.9	0.08		0.0719	0.07	0.0048	0.0160	0.0023	0.0058			
71-337	TWR-1	3-31-71		7.6	4.2	0.12		0.226	0.04	0.0013	0.0051	0.0018	0.0023			<0.00003
71-338	AB-1	3-31-71		4.1	0.66	0.02		0.0117	0.38	0.0010	0.0018	0.0006	0.0010	<0.000001	<0.000001	
71-339	AB-2	3-31-71		18	0.94	0.29		0.0577	0.17	0.0037	0.0120	0.0028	0.0014	<0.000001	<0.000001	
71-340	AB-3	3-31-71		16	8.9	0.24		0.0754	0.09	0.0027	0.0080	0.0016	0.0054	<0.000001	<0.000001	
71-341	AB-4	3-31-71		13	5.3	0.16		0.0477	0.23	0.0023	0.0070	0.0023	0.0048	<0.000001	<0.000001	
71-342	EC-1	3-31-71		12	5.1	0.10		0.0297	3.30	0.0026	0.0160	0.0057	0.0057			
71-343	EC-2	3-31-71		10	1.7	0.04		0.0280	0.33	0.0020	0.0100	0.0015	0.0023			
71-344	EC-3	3-31-71		9.1	4.0	0.07		0.0260	1.40	0.0012	0.0096	0.0015	0.0063			
71-345	EC-4	3-31-71		3	1.1	0.03	0.005	0.0382	2.0	0.0020	0.0041	0.0009	0.0019			
71-346	EC-5	3-31-71		6.4	2.2	0.04		0.00828	0.35	0.0028	0.0065	0.0012	0.0029			
	EPA Limits			[illegible]	[illegible]	[illegible]		[illegible]		0.005	0.005					0.0001

Table 4

Charleston Harbor Sediments Analysis, August, 1972 (S.C. Poll. Cont. Auth.)

Station	Volatile Solid 600°	COD Dry	TKN Dry	GREASE Dry	PB Wet	ZN Wet	HG Dry	% Total Solids
Ashley River	**% Dry**		**Mg/Kg**					
A13C	7.2	73800	1360	3370	20.4	43.9	.48	60.0
A19A	12.2	86600	1720	1130	23.8	30.6	.39	57.1
A19B	7.1	44000	1370	1960	39.2	77.6	.35	52.8
A19L MAR.	13.4	108000	1790	3510	17.0	28.3	.33	48.4
A2OB	4.7	40200	730	830	47.6	11.8	.28	65.8
A21A	7.2	93000	1600	1990	44.6	74.0	—[2]	52.9
A21B	18.1	25500	700	590	ND[1]	27.6	.16	80.0
A3A	10.8	107900	1990	1580	28.7	2.9	.81	48.0
A3B	12.1	75500	1440	830	43.5	47.6	1.02	49.0
A5B	14.4	126900	4440	3900	39.6	43.5	.73	39.8
A7R MAR.	12.7	129200	1440	11019	46.8	63.1	1.08	37.0
A9A	13.5	103000	2048	1890	52.1	241.8	1.20	39.6
A9B	2.75	40200	730	450	50.7	69.9	.24	74.2
A9C	11.5	100000	2680	1220	31.9	56.1	.42	46.8
A11B	10.9	111000	4030	2160	42.8	62.4	.39	51.7
A11C	13.4	108900	2090	1120	46.4	75.9	.75	41.3
A13B	8.58	66100	1800	1220	31.6	38.9	.19	51.4
A18A	15.5	149400	1290	2840	42.3	46.3	.44	38.5
A18C	1.45	14000	1740	301	19.8	18.5	.93	76.3
A19 R MAR.	13.2	122000	1790	2120	25.2	6.0	13.2	42.0
A20C	1.61	23000	930	4240	21.5	22.3	.14	76.3
A13A	6.6	58300	1050	820	27.5	27.0	.15	76.0
A7C	7.3	32300	590	1140	13.6	17.5	.23	72.3
A19C	8.8	73300	2240	900	25.6	19.8	.23	50.7
101 B	17.1	140800	1070	670	31.7	25.0	.34	76.0
103 B	8.5	100000	1490	540	42.5	149	.68	50.6
102A	12.6	60200	2700	490	60.4	88.1	1.12	57.3
A21C	12.4	66000	590	690	18.8	17.8	.58	85.0
A18 B	10.4	37000	690	1010	23.2	46.0	.38	83.1
A20A	9.5	54600	1090	550	22.1	36.2	.09	69.7
102 C	12.2	92000	2080	2230	35.8	47.2	—[2]	61.5
101 A	10.2	70300	1970	3220	—[2]	53.8	.15	58.0
103 C	8.3	83600	1650	2990	24.3	41.0	.24	55.9
101 C	9.8	110300	2500	3690	91.1	59.4	.72	58.5
A 3C	2.8	46000	830	530	21.5	57.0	.35	72.9
A5A	5.3	49700	1330	2870	40.5	41.3	.33	65.5
A 5C	8.0	106000	1360	1930	24.3	13.6	.23	59.5
A 7A	11.6	115000	3100	11700	45.9	74.1	.50	44.3
A 7B	2.7	26800	609	1190	19.9	10.7	.10	77.4
A 7L MAR.	5.8	70700	1820	1250	17.0	28.3	.43	60.0
A11A	10.2	109000	2460	10000	43.0	72.3	.24	49.9
Average (Ashley)	9.32	79270	1682	2288	32.7	45.8	.45	59.0

Table 4 (cont.)

Station	Volatile Solid % Dry 600°	COD Mg/Kg Dry	TKN Mg/Kg Dry	GREASE Mg/Kg Dry	PB Mg/Kg Wet	ZN Mg/Kg Wet	HG Mg/Kg Dry	% Total Solids
Cooper River								
CLM2	20.7	27500	510	720	33.7	39.8	.54	87.9
CLM3	7.1	163600	1040	602	32.2	43.1	.34	37.4
CLM1	12.7	111100	1650	3470	28.6	32.1	.25	57.4
CO2R	3.5	37300	810	1010	20.9	7.5	.34	68.6
CO3L	15.7	43000	820	570	19.1	9.9	.15	65.0
CO1L	17.8	67400	875	660	33.7	32.7	.26	57.6
CO1R	16.6	55000	840	390	27.0	10.4	.29	70.8
CO2L	32.2	79600	1580	1270	58.9	44.7	.17	49.9
CO3L2" Deep	4.9	43100	1070	360	32.7	42.6	.36	72.9
CO3M	3.9	15700	730	510	16 2	20.7	.40	73.2
CO2M	6.4	76400	1390	7760	19.8	11.5	.30	42.0
CO1M	5.1	54400	980	790	24.8	13.9	.18	60.3
Average (Cooper)	12.2	18880	1029	1514	28.9	25.7	.29	61.9
Wando River	% Dry		Mg/Kg					
W-1-L	8.6	31600	710	980	19.7	12.6	0.29	63.5
W-1-M	7.43	60000	1300	1350	33.1	32.9	0.97	58.0
W-1-R	5.62	30700	1040	1110	29.2	20.3	0.58	53.3
W2L	3.2	23300	590	860	13.6	19.4	0.17	70.4
W2M	2.8	32600	660	1070	16.9	20.2	0.40	72.9
W2R	11.3	46500	440	1110	27.1	41.1	0.68	74.6
W3L	10.2	105000	2140	3980	35.6	47.9	0.33	43 6
W3M	5.57	22800	500	4320	24.9	16.8	0.49	70.4
W3R	10.9	124800	2860	3400	35.2	17.1	0.29	58.5
W4L	15.1	155500	3520	10020	5.8	13.4	0.69	37.3
W4M	0.6	1200	470	2880	ND[1]	7.5	0.21	25.2
W4R	3.5	31000	610	3010	12.6	8.2	0.11	67.4
W5L	4.4	1800	360	233	28.2	48.9	0.04	28.1
W5R	9.0	63300	800	3390	20.3	51.2	0.43	34.7
W6M	20.3	28600	570	2760	42.9	24.4	0.24	34.4
W6R	3.7	20400	3030	3750	30.7	24.0	—[2]	36.8
W7L	3.9	37500	910	1450	—	29.0	0.43	62.3
W7M	4.0	36300	544	2680	26.8	18.1	0.51	33.3
W7R	4.0	35100	980	3270	21.0	12.4	0.27	36.3
W8R	4.2	34100	270	3290	28.6	12.7	0.20	22.5
W6RM	15.5	111400	2800	3110	42.3	31.0	2.83	64.0
Average (Wando R.)	7.3	49214	1195	2763	23.0	24.2	.50	49.9

[1] "N. D." denotes none detected.

[2] Denotes sample run, but description lost during analysis.

Table 5

PESTICIDE ANALYSES
Bottom Sediments
(ug/kg)

U. S. G. S. Study

Sampling Site	Date & Time	Aldrin	DDD	DDE	DDT	Dieldrin	Endrin	Heptachlor	Lindane	2,4-D	2,4,5-T	Silvex
PB-1 Cooper R. at mile 5.2 [1]	5-4-71 0900					1.7	0.0					
PB-2 Cooper R. at mile 8.0 [2]	5-4-71 0930					1.1	0.0					
PB-3 Cooper R. at mile 10.3 at mouth of Goose C. [3]	5-4-71 1020					0.0	0.0					
PB-4 Clouter C. 1.5 mile from North Confluence with Cooper R.	5-4-71 1045	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
PB-5 Clouter C ¼ mile from Northern Confluence with Cooper R. [4]	5-4-71 1035					0.0	0.0					
PB-6 Cooper R. at mile 15.5 [5]	5-4-71		0.0		0.0	0.0	0.0					
PB-7 Cooper R. at mile 19.0	5-4-71 1152	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0			
PB-8 Durham C. Canal ¼ mi. from Northern Confluence with N. Branch Cooper R. [6]	5-4-71 1330	0.0	8.4	1.5	0.0	0.0	0.0	0.0	0.0			
PB-9 E. branch 3.5 Cooper R. at mile 3.54 [7]	5-4-71 1255		0.0		0.0	0.0	0.0					
PB-10 W. branch Cooper R. at mile 35.4 [8]	5-4-71 1350	0.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0			
PB-11 Winyah Bay 1 mile below Sampit River	5-25-71	0.0	4.2	3.4	0.0	9.1	0.0	0.0	0.0			
PB-12 Winyah Bay Channel marker #22, Georgetown	5-4-71 1100	0.0	0.4	0.0	0.0	1.1	0.0	0.0	0.0			

[1] PCB=80 ug/kg. Remaining Pesticides cannot be confirmed due to PCB interference.
[2] PCB=125 ug/kg. Remaining Pesticides cannot be confirmed due to PCB interference.
[3] PCB=100 ug/kg. Remaining Pesticides cannot be confirmed due to PCB interference.
[4] PCB=30 ug/kg ± 50%. DDD, DDE are present but cannot be confirmed due to PCB interference.
[5] PCB=40 ug/kg ± 50%. Remaining pesticides cannot be confirmed due to PCB interference.
[6] PCB=30 ug/kg ± 50%.
[7] PCB=50 ug/kg ± 50%. Remaining pesticides cannot be confirmed due to PCB interference.
[8] Suspect presence of PCBs.

TABLE 6

Pinopolis Hydroelectric Power Plant at Pinopolis, S. C.

Location Lat 33° 14' 40", Long 79° 59' 30", at power plant 0.7 miles upstream from Atlantic Coast Line Railroad bridge and 2.8 miles northeast of Pinopolis, Berkeley County.

Drainage area 14,825 square miles, approximately.

Average discharge 26 years (1944-64 and 1968-72), 14,393 cfs.

Remarks Discharge given is that passed through the turbines only. Additional flow enters West Branch Cooper River through spillage, and through lockages.

Lake Moultrie is formed by earth dikes and dam, with concrete navigation lock; dikes and dam completed in 1941. Storage began in November 1941. Water is diverted through canal from Lake Marion and discharged through tailrace canal into West Branch Cooper River. Usable capacity, 33,170,000,000 cu ft between elevations 60.0 ft msl (normal limit of drawdown) and 76.8 ft msl (maximum normal elevation). Dead storage, about 19,600,000,000 cu ft.

Monthly and yearly mean discharge, in cubic feet per second

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1944						13,615	11,467	11,770	10,831	10,402	10,702	12,155	11,567
1945	13,150	12,390	12,342	12,131	9,760	8,049	9,714	8,949	13,960	16,025	13,967	11,481	11,876
1946	17,634	18,342	17,999	17,787	19,253	14,845	10,029	14,125	12,050	12,964	15,953	13,509	15,374
1947	13,306	20,495	15,874	12,954	11,324	12,162	11,212	10,780	10,670	9,447	16,185	21,175	13,799
1948	24,778	24,358	25,118	23,526	14,260	13,750	13,058	12,567	12,502	13,027	14,876	22,095	17,904
1949	23,885	25,293	22,359	17,908	21,611	13,696	14,514	15,712	23,629	24,330	21,089	18,645	20,222
1950	15,803	13,507	12,972	13,504	12,365	12,700	10,222	9,146	9,674	9,467	11,268	12,686	11,984
1951	13,327	13,343	11,251	10,733	12,534	11,648	11,467	11,087	8,736	6,667	6,425	8,305	10,460
1952	9,979	10,386	21,970	21,126	12,773	13,608	11,966	10,938	11,654	14,759	13,860	14,944	13,997
1953	7,162	10,675	22,150	18,296	12,066	9,264	8,057	14,233	11,509	8,127	7,906	11,459	11,737
1954	13,759	16,751	19,019	14,323	11,863	13,377	9,776	3,435	3,206	3,661	5,306	4,719	9,933
1955	10,422	6,448	10,466	9,551	9,413	11,104	4,620	4,286	6,893	11,820	6,459	4,574	8,005
1956	4,778	6,165	14,168	15,219	15,474	10,067	6,502	4,581	2,146	4,299	9,271	5,445	8,093
1957	6,800	12,451	12,574	14,467	10,340	13,546	14,733	6,715	4,412	6,359	15,377	22,629	16,736
1958	20,067	21,630	24,630	25,369	21,766	14,438	13,799	12,089	11,184	8,358	7,761	8,449	15,795
1959	8,763	19,019	18,202	17,279	11,959	14,709	15,926	17,855	14,362	20,370	20,072	19,785	16,442
1960	25,142	26,319	26,979	23,820	19,825	10,913	9,771	13,402	16,106	10,240	9,180	10,457	16,846
1961	15,677	15,355	24,914	25,909	24,983	10,775	19,479	13,880	17,187	8,993	6,699	14,666	16,543
1962	24,750	25,932	26,207	27,020	13,857	14,390	13,238	9,653	6,385	6,419	8,683	15,177	15,893
1963	12,926	17,101	23,641	16,027	9,036	12,595	14,400	12,846	5,016	6,674	7,368	13,461	12,579
1964	22,944	24,904	26,831	27,281	18,296	13,069	14,194	20,429	23,459	25,758	24,892	22,657	22,050
1968	27,507	19,646	12,796	9,150	9,047	17,638	15,308	11,795	4,784	7,090	11,053	14,784	13,379
1969	9,765	12,200	22,398	21,846	15,981	12,648	11,205	13,827	11,400	11,191	12,444	17,517	15,074
1970	17,285	11,152	4,960	16,052	9,985	6,862	6,175	15,075	10,893	4,805	15,939	8,943	10,654
1971	19,347	28,556	28,031	22,169	17,319	13,971	13,930	19,871	16,088	23,095	13,702	25,203	20,077
1972	25,757	28,336	16,710	16,047	17,901	19,152	15,733	14,243	8,156	7,260	14,355	23,188	17,207

TABLE 7

Charleston Harbor Water Quality Data collected by the S. C. Department of Health and Environmental Control during the period February, 1973 to April, 1974.

	Sta MD-48*		Sta MD-43*		Sta MD-50*		Sta MD-47*		Sta MD-46*	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
T-NO_3 mg/l-N	0.0-.24	0.10	0.0-.37	0.10	.01-.17	0.09	.00-1.22	0.03	.00-.26	0.09
O-PO_4 mg/l	0.0-.30	0.14	0.0-.63	0.13	.03-.90	0.23	0.0-.33	0.09	.02-.26	0.12
Fe ug/l	100-662	328.7	30-510	270	100-1059	493	100-1246	412.1	50-652	230.5
Pb ug/l	200	200	100	100	200	200	200	200	200	200
Hg ug/l	0.5-1.2	0.73	0.5-1.5	0.93	0.5-0.8	0.6	0.1-4.15	1.15	0.1-1.65	0.65
Temp C^o	6-28	20.5	13-29	22.4	7-28	20.6	7-28	19.2	7-27	19.3
Final DO	5.6-7.2	6.38	5.5-7.3	6.4	5.4-7.0	6.25	5.4-7.6	6.6	4.45-7.3	6.23
BOD_5 mg/l	1.25-2.8	1.86	1.1-3.3	2.0	1.2-3.5	2.19	0.7-3.7	1.98	0.9-3.95	0.83
pH (lab)	6.8-7.85	7.3	6.5-6.9	6.6	6.7-7.4	7.0	6.5-7.3	6.95	6.6-7.7	7.2
Total Alk.	16-120	64	21-34	24	10-180	57	26-67	45	36-90	60
Fecal Col:/100ml	10-1460	347	8-1320	199	75-880	284	10-4000	852	10-2760	385

*Station locations

MD-48 South Channel, Charleston Harbor off Ft. Johnson near bell buoy #28.
MD-43 Cooper River at channel marker #72 near U.S. Ammunition Depot.
MD-50 Ashley River at A.C.L.R.R. Bridge (Bee's Ferry).
MD-47 Town Creek (West Side of Drum Island) under Grace Memorial Bridge.
MD-46 Cooper River under Grace Memorial Bridge.

TABLE 8

COOPER RIVER EFFLUENT DISCHARGES

Source	Approximate Discharge/Day (Gallons)	Type Treatment
Charleston County		
Sherwood Trailer Park	60,000	Oxidation pond
T.E.C.-B.D.C.	29,500	Stabilization pond
Highland Trailer Park	25,000	Aerated pond & chlorination
Airco Alloys and Carbide Co.	20,000	Modified activated sludge system
North Chas. P.S.D.-Hawthorne Pond	3,000,000	Treatment plant
Oakcrest S/D	120,000	Stabilization pond, chlorination
Paramount Trailer Park	85,000	Aerated lagoon, chlorination
Hobcaw View Apartments	---	---
North Chas. A.F.B.-Radar Station	---	Chlorination
Econo Travel Motel	5,000	Aerated lagoon, chlorination
Swifts Fertilizer	10,000	Oxidation pond
Westvaco	45,000,000	Activated sludge plant
Donerree Village	---	Aerated pond and chlorination
Etiwan Fertilizer	7,500	Aeration treatment plant & chlorination
F.S. Royster Fertilizer Co.	---	Cooling pond
EARCO Div. - Koppers	---	Sand trap
ROBO Automatic Car Wash	8,000	Grease and grit trap
Town of Mt. Pleasant - Wakendaw	120,000	Treatment plant
Town of Mt. Pleasant - Hickory Shadows	101,000	Aeration and chlorination
Town of Mt. Pleasant - Parrish Place	180,000	Stabilization ponds
Town of Mt. Pleasant	570,800	Treatment plant
Town of Sullivans Island	570,000	Oxidation ditch with chlorination
Northwood Estates _ Northwood Mall	375,690	Treatment lagoon
Broyhill - Whitnel Industries	3,750	Aeration and chlorination
Baptist College at Charleston	350,000	Oxidation pond and chlorination
North Chas. Cons. P.S.D.- Eglin St.	10,000,000	Treatment plant
Berkeley County		
Shannon Park, Berkeley Square S/D	-----	Ponds
Lowcountry Girl Scout Camp	12,000	Oxidation pond & chlorination
Berkeley Country Club S/D	18,000	Treatment plant
Pimlico S/D	40,000	Treatment plant
Jefferies Steam Plant	6,000	Treatment plant
U.S. Navy - Short Stay	10,000	Activated sludge system
Central High School	---	Oxidation pond
U. S. Navy - Pier A	1,000	Aeration system
U. S. Navy - Southside	100,000	Activated sludge system
Verona Corporation	3,000,000	Eqlz.,nutzl.,aera.,stabl.&settling ponds
S.C. Electric and Gas - Bushy Park Unit #1	464,931,000	Ash sluice pond, cooling tower
U. S. Navy Menriv Ponds	600,000	Oxidation ponds
St. James Estates S/D	45,200	Activated sludge system
Otranto Dev.	---	----
Sunrise Trailer Court	22,500	Oxidation pond
Sedgefield Dev.	155,000	Treatment plant
U. S. Navy Pomflant ponds	75,000	Oxidation ponds
Beverly Hills S/D	315,000	Stabilization ponds
Forest Lawn S/D	80,000	Stabilization pond
Hwy 6 Laundromat	---	Screen and spray injection,chlorination

TABLE 9

Summary of Physical ,Chemical and Microbiological Data Collected by the Environmental Protection Agency During October and November, 1971

October, 1971

Sta		Temp °C	pH Units	Chloride mg/l	DO mg/l	BOD_5 mg/l	TOC mg/l	Nitrogenous Compounds, mg/l TKN	NH_3-N	NO_2-NO_3	Phosphorus mg/l Total-P	Ortho-P	Nonfilterable Residue, mg/l Total	Vol	Metals, ug/l Cu	Cr	Pb	Zn	Mn	Fe	Hg	Fecal Coliform /100 ml
	Avg	21 9	7 7	7,530	5 3	1 1	5 2	0 42	0 05	0 05	0 05	0 04	37	14	45	<20	170	40	85	1070	< 20	830'
1	Max	23 0	8 3	13 400	6 7	1 4	6 0	0 54	0 10	0 10	0 08	0 07	63	21	80	<20	240	50	80	1580	< 20	7900
	Min	20 0	6 9	1,640	5 1	0 8	4 0	0 35	0 04	0 02	0 02	0 02	12	6	30	<20	100	30	50	560	< 20	330
	Avg	22 1	7 6	3 225	6 4	1 1	4 7	0 47	0 05	0 04	0 03	0 02	16	6	--	--	--	--	--	--		240
3	Max	23 5	8 3	10 900	7 7	2 6	6 0	0 54	0 06	0 06	0 04	0 04	31	9	--	--	--	--	--	--		1300
	Min	20 5	7 2	520	4 7	0 4	4 0	0 40	0 04	0 03	0 02	0 02	6	2	--	--	--	--	--	--		50
	Avg	21 3	7 7	310	7 0	0 8	4 7	0 41	0 05	0 05	0 03	0 02	19	5	--	--	--	--	--	--		87
4	Max	22 0	8 0	2,670	7 8	1 1	5 0	0 58	0 07	0 10	0 04	0 03	25	9	--	--	--	--	--	--		110
	Min	20 0	6 5	10	3 4	0 4	4 0	0 23	0 01	0 03	0 02	0 01	9	2	--	--	--	--	--	--		80
	Avg	21 6	7 5	9	7 7	--	5 0	0 45	0 05	0 05	0 04	0 02	17	5	--	--	--	--	--	--		120
5	Max	23 0	7 8	16	8 0	--	6 0	0 59	0 06	0 05	0 05	0 04	24	6	--	--	--	--	--	--		170
	Min	20 5	7 1	7	7 4	--	4 0	0 28	0 04	0 03	0 03	0 01	9	4	--	--	--	--	--	--		50
	Avg	21 6	7 4	8	7 6	0 8	4 7	0 39	0 04	0 04	0 04	0 01	12	3	35	<20	<80	45	25	855	< 20	290
6	Max	22 0	7 7	9	8 0	1 0	6 0	0 46	0 06	0 05	0 05	0 02	17	4	40	<20	<80	60	30	920	< 20	2300
	Min	21 0	7 0	8	7 2	0 5	4 0	0 26	0 03	0 03	0 02	<0 01	7	1	30	<20	<80	30	20	790	< 20	130
	Avg	21 2	7 3	8	7 6	0 9	4 2	0 42	0 07	0 05	0 04	0 03	16	4	45	<20	<80	35	30	945	< 20	110
7	Max	22 0	7 7	10	8 2	1 0	5 0	0 50	0 12	0 09	0 07	0 07	24	4	50	<20	<80	40	40	1190	< 20	230
	Min	20 5	6 5	7	7 1	0 4	4 0	0 36	0 04	0 03	0 03	0 01	9	3	40	<20	<80	30	20	700	< 20	20
	Avg	21 8	7 4	8	7 8	--	5 2	0 44	0 04	0 01	0 04	0 02	9	3	--	--	--	--	--	--		26
8	Max	22 5	7 6	9	8 4	--	6 0	0 50	0 08	0 01	0 06	0 03	14	5	--	--	--	--	--	--		170
	Min	21 0	7 0	7	7 3	--	5 0	0 38	0 03	<0 01	0 02	0 01	3	1	--	--	--	--	--	--		20
	Avg	20 8	7 2	9	7 4	0 9	4 5	0 46	0 04	0 03	0 03	0 01	9	3	25	<20	<80	20	20	740	< 20	150
9	Max	21 5	7 8	11	8 0	1 1	5 0	0 58	0 06	0 04	0 03	0 02	12	4	30	<20	<80	20	30	1100	< 20	330
	Min	20 0	6 4	7	7 0	0 8	4 0	0 33	0 03	0 02	0 02	0 01	8	2	20	<20	<80	20	10	380	< 20	70

November, 1971

Sta		Temp °C	pH Units	Chloride mg/l	DO mg/l	BOD_5 mg/l	TOC mg/l	Nitrogenous Compounds, mg/l TKN	NH_3-N	NO_2-NO_3	Phosphorus mg/l Total-P	Ortho-P	Nonfilterable Residue, mg/l Total	Vol	Metals, ug/l Cu	Cr	Pb	Zn	Mn	Fe	Hg	Fecal Coliform /100 ml
	Avg	17 9	7 7	9,030	6 4	0 9	5 9	0 31	0 02	0 05	0 05	0 04	44	12	67	<20	232	135	58	2212	30	460'
1	Max	22 0	8 1	14 800	7 4	1 0	9 0	1 00	0 06	0 09	0 12	0 10	128	34	100	<20	480	380	100	6650	50	1700
	Min	15 0	7 2	3,020	5 3	0 8	4 0	0 14	<0 01	0 01	0 02	0 02	13	2	40	<20	130	60	20	650	< 20	130
	Avg	18 3	7 5	6,115	6 3	0 8	6 0	0 26	0 03	0 06	0 06	0 05	45	11	--	--	--	--	--	--		200
3	Max	22 5	8 0	13 100	7 1	1 0	10 0	0 40	0 01	0 11	0 20	0 10	146	31	--	--	--	--	--	--		790
	Min	15 5	7 0	323	5 1	0 6	4 0	0 17	<0 01	0 02	0 02	0 02	13	3	--	--	--	--	--	--		20
	Avg	18 2	7 5	2 620	6 9	0 6	6 0	0 27	0 02	0 08	0 04	0 04	20	6	--	--	--	--	--	--		90
4	Max	22 0	8 2	8 900	7 7	0 8	8 0	0 48	0 07	0 15	0 09	0 07	44	16	--	--	--	--	--	--		330
	Min	16 0	6 7	9	5 9	0 4	5 0	0 13	<0 01	0 05	0 02	0 01	9	2	--	--	--	--	--	--		20
	Avg	17 9	7 5	135	7 6	--	7 7	0 39	0 03	0 12	0 04	0 03	11	3	--	--	--	--	--	--		60
5	Max	22 5	8 5	630	8 2	--	10 0	0 83	0 05	0 14	0 08	0 07	23	12	--	--	--	--	--	--		230
	Min	15 0	6 9	9	7 2	--	6 0	0 19	<0 01	0 09	0 02	0 02	3	1	--	--	--	--	--	--		20
	Avg	17 6	7 3	14	7 7	0 6	6 7	0 38	0 02	0 12	0 04	0 03	11	4	23	<20	<80	45	50	1120	< 20	100
6	Max	22 5	7 8	26	8 5	0 7	9 0	0 77	0 06	0 17	0 07	0 05	45	10	40	<20	<80	140	100	1320	< 20	490
	Min	14 5	6 3	10	6 8	0 3	3 0	0 15	<0 01	0 06	0 02	0 02	1	1	10	<20	<80	20	20	860	< 20	20
	Avg	17 6	7 3	12	7 2	0 7	6 1	0 42	0 02	0 13	0 04	0 02	11	4	27	<20	115	28	28	907	< 20	380
7	Max	22 0	8 5	28	8 5	1 0	9 0	0 95	0 06	0 17	0 09	0 03	46	11	60	<20	150	40	60	1250	< 20	2400
	Min	15 5	6 9	9	5 0	0 4	4 0	0 12	<0 01	0 06	0 01	0 01	1	1	10	<20	<80	20	10	600	< 20	80
	Avg	18 5	7 4	10	8 5	--	4 6	0 34	0 03	0 16	0 03	0 02	6	2	--	--	--	--	--	--		30
8	Max	22 5	7 9	13	8 9	--	7 0	0 57	0 06	0 21	0 07	0 04	17	7	--	--	--	--	--	--		130
	Min	15 0	6 7	9	7 6	--	3 0	0 15	0 01	0 14	0 01	<0 01	1	1	--	--	--	--	--	--		20
	Avg	17 2	7 3	12	7 3	0 8	6 9	0 41	0 02	0 11	0 04	0 03	7	3	32	<20	90	32	32	988	< 20	110
9	Max	22 0	8 0	20	9 4	0 8	10 0	0 95	0 03	0 15	0 07	0 06	16	8	60	<20	100	40	50	1250	< 20	330
	Min	14 5	7 0	8	5 8	0 4	4 0	0 16	<0 01	0 07	0 02	0 02	2	1	20	<20	<80	20	10	630	< 20	20

'Geometric mean

TABLE 10

ASHLEY RIVER EFFLUENT DISCHARGES

Source	Approximate Discharge/Day (gallons)	Type Treatment
Charleston County		
Pepperhill Development	542,000	Oxidation pond, 2 lagoons, chlorination
St. Andrews P.S.D.-Savage Road	85,000	Aerated pond
James Island	-----	------
Charleston AFB	40,000	Package treatment plant
Irongate Development - Shadowmoss	80,000	Oxidation pond
Dortown Apartments	50,000	Aeration and chlorination
North Chas.Cons.P.S.D.-Forest Hills	196,000	Treatment plant
St. Andrews P.S.D.	85,000	Aeration
Pierpont	-----	------
Bird and Sons, Incorporated	500,000	Disposal in marsh
Lockheed-Georgia	200,000	Treat for industrial wastes
S.C. Marine Resources enter	12,000	Chlorinated in a contact detention tank
City of Charleston-Plum Island Plant	10,000,000	Treatment plant
Marlborough Club Dev.	-----	------
Seaport Laundromat	-----	------
A.M.E. Apartments	-----	------
Hardees Foods	4,000	Aeration and chlorination
Queensborough S/S	59,100	Stabilization lagoon
Westchester Dev.	45,000	Stabilization pond and chlorination
Meyer Park Plaza	10,000	Oxidation pond
Lawton Bluff S/D	110,000	Stabilization pond, chlorination, detention
Ashcroft-Blairwoods-Harvey Woods S/D	145,600	Stabilization pond
Farmington S/D	102,000	Pond and chlorination
Lynwood Dev.	94,000	Treatment plant
Whitehouse Plantation	99,800	Stabilization pond and chlorination
City of Charleston-Airport	150,000	Oxidation pond
S.C. Electric and Gas-Crew Quarters	500	Aeration
Ladson Village Trailer Park	44,125	Treatment plant
KOA Campgrounds	-----	------
Ford's Redi Mix Concrete	750	Treatment plant
Mobile Chemical Company	187,000	Oxidation pond
Columbia Nitrogen	40,000	Septic tank
S. C. Electric and Gas - Hagood Plant	2,400	Oxidation pond
G.E. - Ladson Plant	6,000	Coagulation, sedimentation, and filtration
North Chas. Cons. P.S.D.-College Heights	50,000	Treatment plant
Arigo Chemicals	-----	Scrubber
W. R. Grace and Co.	-----	Cooling water pond
Koppers, Incorporated	-----	Sand trap
Dorchester County		
North Tranquil Acres	200,000	Stabilization pond
South Tranquil Acres	-----	Stabilization pond
Quail Arbor	84,672	Treatment lagoon
Greenhurst	122,500	Ponds
Coastal Center	-----	------
Fairlawn	-----	------
Rose Hill	53,000	Ponds
Woodlawn	27,000	Ponds
Cono Flow Corporation	-----	Oxidation ponds
Ashley Forest Estates	27,500	Stabilization ponds
Country Club Apartments	-----	Ponds
Oakdale	75,000	Stabilization pond
Town of Summerville	350,000	Treatment plant
Belmont	33,920	Oxidation pond
Knightsville Elementary School	18,000	Oxidation pond
Berkeley County		
Cloverleaf Trailer Park	6,720	Stabilization pond

Table 11

MONTHLY OCCURRENCE OF FISH SPECIES - CHARLESTON HARBOR AREA 1970 - 1971 (S.O.= Seasonal Occurrence)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV.	DEC.	TOTAL	S.O.
Squalidae														
Squalus acanthias		1											1	C
Rajidae														
Raja eglanteria														Y
Dasyatidae														
Dasyatis sabina					1		1			1			3	Y
Dasyatis sayi														Y
Gymnura micrura														U
Acipenseridae														
Acipenser oxyrhynchus	1												1	U
Lepisosteidae														
Lepisosteus osseus											1		1	U
Anguillidae														
Anguilla rostrata									1	1	2	1	5	Y
Ophichthidae														
Ophichthus gomesi								1					1	U
Clupeidae														
Alosa aestivalis		171	5		1							1	178	U
Brevoortia tyrannus	240	2289	817	153	21	12	27	5	66	5	9	202	3846	Y
Clupea species	4	2										2	8	C
Opisthonema oglinum	8	73	4	3		1	4	15			1	13	122	Y
Engraulidae														
Anchoa hepsetus					56	2	27	43	60	12	2	2	204	Y
Anchoa mitchilli	547	960	858	896	2220	398	79	148	769	768	575	594	8512	Y
Synodontidae														
Synodus foetens							9	1	6	3	13	1	33	Y
Ictaluridae														
Ictalurus catus			1	1								6	8	Y
Ariidae														
Arius felis							2	3	4	46			55	W
Batrachoididae														
Opsanus tau		2					2	15	3	1			23	Y
Gadidae														
Urophycis regius		355	138	164	75								732	C
Ophidiidae														
Rissola marginata										2	2		4	Y

Table 11 (Cont'd)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Atherinidae														
Menidia menidia	69	20	1	35									125	Y
Syngnathidae														
Syngnathus fuscus											1	1	2	Y
Serranidae														
Centropristis striata							6	2	13		4		25	Y
Centropristis philadelphica								2		4		1	7	U
Pomatomidae														
Pomatomus saltatrix							6						6	U
Rachycentridae														
Rachycentron canadum									1				1	U
Carangidae														
Caranx hippos											2		2	W
Chloroscombrus chrysurus							1	8	12	133	1		155	W
Selene Vomer						2	16	19	20	13	2	2	74	W
Vomer setapinnus								13	4				17	U
Gerreidae														
Eucinostomus argenteus							1				7		8	U
Poradasyidae														
Orthopristis chrysoptera							1						1	W
Sparidae														
Lagodon rhomboides							6	5	1				12	Y
Sciaenidae														
Bairdiella chrysura	1	18	16	4	6	1	2	155	278	126	210	189	1006	Y
Cynoscion nebulosus												1	1	Y
Cynoscion regalis		7		1	6	220	628	513	401	150	40	25	1991	Y
Larimus fasciatus											1		1	Y
Leiostomus xanthurus	11	133	168	128	3945	2410	1554	790	279	47	94	58	9617	Y
Menticirrhus americanus								30	6	23		1	60	Y

Table 11 (Cont'd)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Menticirrhus littoralis														W
Micropogon undulatus	66	17	56	728	643	5113	660	303	535	298	48	37	8504	Y
Stellifer lanceolatus	5	31	2	3	20			370	2302	2818	3050	1623	10224	Y
Ephippidae														
Chaetodipterus faber							1	13	1	2			17	W
Labridae														
Halichoeres bivittatus						3					3		6	U
Uranoscopidae														
Astroscopus y-graecum														U
Gobiidae														
Gobionellus oceanicus										1		1	2	W
Trichiuridae														
Trichiurus lepturus					27	11	2	1	1				42	W
Scombridae														
Scomberomorus cavalla														U
Scomberomorus maculatus							4	3					7	W
Stromateidae														
Peprilus alepidotus		1					27	36	10	5			79	W
Peprilus triacanthus			1	12	32	1	4	6					56	W
Triglidae														
Prionotus carolinus			2	7	3			1	1		1		15	Y
Prionotus tribulus		3				4	1		4	7	7		26	Y
Bothidae														
Ancyclopsetta quadrocellata	1	8	1		5								15	Y
Citharichthys spilopterus							8	111	1	16	20	14	170	Y
Etropus crossotus			1				3						4	Y
Paralichthys albigutta				1									1	U
Paralichthys dentatus	1		2	1	4	1	5	12	7	3	11		47	Y
Paralichthys lethostrigma	3	10	7		2	5	1	4	7	8	3	2	52	Y
Soleichthalmus aquosus			1	2									3	Y

Table 11 (Cont'd)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Sleidae														
Trinectes maculatus			2	3	5	18	2	55	160	58	4	5	312	Y
Cynoglossidae														
Symphurus plagiusa		49	80	93	12	142	14	268	361	661	207	250	2137	Y
Balistidae														
Monocanthus hispidus							1			1	2		4	Y
Tetraodontidae														
Lagocephalus laevigatus														U
Sphoeroides maculatus									2				2	U
Diodontidae														
Chilomycterus schoepfi											1		1	U

Y = Occurs year long

C = Present only during colder months

W = Present only during winter months

U = Uncommon

Total No. 48,874

Source: South Carolina Water Resources Commission

Table 12

Monthly Occurrence of Fish Species - Morris Island Area 1970 - 1971 (S.O. = Seasonal Occurrence)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Squalidae														
Squalus acanthias														
Rajidae														
Raja eglanteria				1									1	Y
Dasyatidae														
Dasyatis sabina					2								2	Y
Dasyatis sayi					1								1	Y
Gymnura micrura					1								1	U
Acipenseridae														
Acipenser oxyrhynchus														
Lepisosteidae														
Lepisosteus osseus														
Anguillidae														
Anguilla rostrata														
Opichthidae														
Ophichthus gomesi														
Clupeidae														
Alosa aestivalis												1	1	U
Brevoortia tyrannus	15	13	732	1	21	18					1	4	805	Y
Clupea harengus		7											7	C
Opisthonema oglinum	2	34			3	29		1				25	94	Y
Engraulidae														
Anchoa hepsetus					227	21	6	19	57	39	23		392	Y
Anchoa mitchilli	81	337	196	111	406	391	35	23	156	350	218	107	2411	Y
Synodontidae														
Synodus foetens														
Ictaluridae														
Ictalurus catus														
Ariidae														
Arius felis														
Batrachoididae														
Opsanus tau														
Gadidae														
Urophycis regius	5	43	127	106	96	27							404	C
Ophidiidae														
Rissola marginata			1	3	8			9				7	28	Y

Table 12 (Cont'd)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Atherinidae														
Menidia menidia		2									4		6	Y
Syngnathidae														
Syngnathus fuscus				1						1		1	3	Y
Serranidae														
Centropristis striata												1	1	Y
Centropristis philadelphica														
Pomatomidae														
Pomatomus saltatrix					2	1		1					4	U
Rachycentruridae														
Rachycentron canadum														
Carangidae														
Caranx hippos														
Chloroscombrus chrysurus							17	1	1	5			24	W
Selene Vomer							3	4					7	W
Vomer setapinnus							2		4	151			157	U
Gerreidae														
Eucinostomus argenteus														
Pomadasyidae														
Orthopristis chrysoptera														
Sparidae														
Lagodon rhumboides														
Sciaenidae														
Bairdiella chrysura		1				3		553			1	2	560	Y
Cynoscion nebulosus														
Cynoscion regalis		1			18	43	48	40	61	53	1	4	269	Y
Larimus fasciatus	2	6		19	3	2	1	59	17	8	1	15	133	Y
Leiostomus xanthurus					27	359	3	14	2		1	5	411	Y
Menticirrhus americanus		2		3			3	50	8	7	4	41	118	Y
Menticirrhus littoralis														
Micropogon undulatus			1		5	300	20	20				3	349	Y

Table 12 (Cont'd)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Stellifer lanceolatus	36	115	81	952	65	28	1	3	99	74	65	2736	4255	Y
Ephippidae														
Chaetodipterus faber								1					1	Y
Labridae														
Halichoeres bivittatus														
Uranoscopidae														
Astroscopus y-graecum		3	2									1	6	U
Gobiidae														
Gobionellus oceanicus														
Trichiuridae														
Trichiurus lepturus					5	19							24	W
Scombridae														
Scomberomorus cavalla														
Scomberomorus maculatus								3	1				4	W
Stromateidae														
Peprilus alepidotus							24	8	2				34	W
Peprilus triacanthus					13	11							24	W
Triglidae														
Prionotus carolinus			1			21	1	1					24	Y
Prionotus tribulus							9	1				1	1	Y
Bothidae														
Ancyclopsetta quadrocellata														
Citharichthys spilopterus								11		1		6	18	Y
Etropus crossotus		1		2								2	5	Y
Paralichthys albigutta														
Paralichthys dentatus							1		1			1	3	Y
Paralichthys lethostigma			1										1	Y
Scophthalmus aquosus			10	1	4	5	1						21	Y
Soleidae														
Trinectes maculatus		2	6	4	2	1	1	26	3			2	47	Y
Cynoglossidae														
Symphurus plagiusa	1		61	19	8	1	7	14	2	3	1	32	149	Y

Table 12 (Cont'd)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	S.O.
Balistidae														
Monacanthus hispidus									1	2		5	8	Y
Tetraodontidae														
Lagocephalus laevigatus					1								1	U
Sphoeroides maculatus							5		1				6	U
Diodontidae														
Chilomycterus schoepfi														

Y = Occurs year long

C = Present only during colder months

W = Present only during winter months

U = Uncommon

Total No. 10,831

Source: South Carolina Water Resources Commission

Table 13

COMMERCIAL FISHERY LANDINGS, CHARLESTON COUNTY, S. C.

Year	Shrimp (Heads-on)		Blue Crabs (Hard)		Oysters (Meats)		Total Shellfish		Total Fish		Grand Total Fish and Shellfish	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
1973	4,215,787	4,480,809	2,408,060	420,358	244,444	130,951	6,903,542	5,047,742	1,579,989	238,217	8,483,531	5,285,959
1972	4,710,971	3,179,618	1,519,222	168,246	490,206	240,934	6,899,266	3,753,421	1,790,965	293,672	8,690,231	4,047,093
1971	5,869,740	3,389,181	1,226,444	106,879	383,985	187,168	7,587,028	3,734,262	1,809,025	224,323	9,396,053	3,958,585
1970	2,841,554	1,673,740	937,745	64,325	262,822	134,197	4,127,534	1,917,319	979,650	153,672	5,107,184	2,070,991
1969	2,943,837	1,731,841	1,206,115	107,800	266,732	136,782	4,436,643	1,984,374	3,159,775	227,467	7,596,418	2,211,841
1968	3,574,480	2,084,974	581,468	43,799	685,437	329,330	4,842,260	2,458,436	4,769,894	309,841	9,612,154	2,768,277
1967	2,347,311	955,257	673,970	38,114	909,352	337,680	3,933,702	1,332,175	4,014,116	200,919	7,947,818	1,533,094
1966	2,298,797	1,164,914	703,703	36,859	1,129,751	464,649	4,142,340	1,669,700	4,396,941	260,965	8,539,281	1,930,665
1965	4,011,809	1,560,617	1,398,618	70,365	962,474	314,012	6,416,298	1,960,181	4,252,578	275,774	10,668,876	2,235,955
1964	1,443,357	475,875	2,096,258	81,294	966,275	379,508	4,584,191	965,011	1,817,127	268,166	6,401,318	1,233,177

Table 14 Monthly abundance of zooplankters in experimental plankton tows, Cooper River, 1963 - 1964.

CATCH PER UNIT OF EFFORT

Species, etc.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Organic detritus, cc.	5.0	4.8	2.0	8.0	10.6	60.0	0.5	13.5	117.0	45.5	5.8	1.0	4.0
Coelenterata	2200.5	633.5	148.0	676.3	673.0	8.8	1.5	0.8	25.2	8.3	4.7	43.5	146.0
Ctenophora		1.8	2.3		3.0							1.3	2.5
Chaetognatha	25.0	54.5	2.5			0.5	1.3		0.8		0.5	0.5	
Polychaeta											0.5		
Misc. worms		1.5		23.3	0.2	0.1							
Copepoda	26.5	1578.0	1.5	81.3	5.5			2.5	81.3	47.5	192.5	92.0	225.0
Mysidacea	29.5	0.5		5.0	3.8	20.5	1.3	25.0	0.5	4.5	0.3	2.5	
Isopoda	3.5	1.0		2.3	0.2	0.8			0.3	0.3	0.5	1.3	
Amphipoda	1.5		1.3	1.0		1.2	0.3	1.0	0.3	0.8			
Paleomonetes							0.3	1.0	0.3	0.8	0.2	0.5	
Paleomonetes larvae	34.0	1.2		6.3	5.8	0.3					0.5	4.5	2.5
Penaeid larvae	11.0	3.8	0.3	4.3	3.0					2.5	0.8		
Misc. shrimp larvae			1.0	1.7		0.5						1.3	57.5
Sergestidae		0.2		2.3								0.5	
Callinectes larvae		6.3	189.5	13.8	0.5						20.8	12.5	47.5
Misc. crab larvae	3.0		0.8		2.0								
Stomatopoda			0.3		0.2						160.0		
Micropogon					0.8	1.8		0.5	0.3	1.0			
Leiostomus								0.5	0.3	1.8			
Anchoa						0.5		0.5		0.5			0.5
Gobisoma								0.3	0.8				
Brevoortia									1.8		0.3		
Lagodon								0.3	0.3				
Misc. fish larvae	1.0	0.3		1.0	0.2			0.8	0.2	0.2			2.0
Mollusca	1.5		0.5							0.5			
Callinectes juveniles									0.3				
Eggs			0.5								7.5		

Source: Reference 24

Table 15 Average monthly catch per unit of effort for zooplankters in experimental plankton tows, Wando River, 1963 - 1964.

Zooplankter	CATCH PER UNIT OF EFFORT												
	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
Coelenterata	2065.9	3859.9	4521.9	3730.0	1309.3	36.7	12.3	0.3	0.3	1.1	0.6	21.3	2375.0
Ctenophora			6.3	0.1								3.2	
Chaetognatha						0.3			0.1				
Polychaeta		0.3											
Misc. worms		0.1			0.2			0.3					
Copepoda	357.2	734.0	1533.3	16.3	9.6		0.3	32.3	157.5	666.9	177.0	246.0	73.5
Mysidacea	2.9	20.1	1.5	91.3	0.9	6.4	1.5	0.3		4.0	2.4	60.0	
Isopoda	0.8	0.5	0.3	0.3	0.3	0.4		0.1	0.1	0.5	1.3	0.8	0.8
Amphipoda	2.0	0.3		0.4	0.2	0.5	0.5	0.5	0.1	2.0			
Paleomonetes		3.0						0.1	0.4	0.1			0.8
Paleomonetes larvae	10.8	34.1	3.0	0.8	1.2	0.1					0.3	2.5	0.8
Penaeid larvae	1.5	1.3	0.6		0.1					1.0	0.9		1.0
Misc. shrimp larvae		0.1		0.1									
Sergestidae		0.1			0.4								
Callinectes larvae	649.2	831.5	389.4	21.6							398.3	2409.4	3163.8
Misc. crab larvae	14.5	1.3	16.0	12.4									
Micropogon						0.3	1.0	0.4	0.3	0.3			
Leiostomus							0.1	1.4	1.5	1.0			
Paralicthys										0.1			
Anchoa							0.1		0.3				0.2
Gobiosoma							0.1						
Stellifer	0.3	0.1		0.3									
Brevoortia								0.1	1.6	0.4	0.3		
Lagodon								0.1					
Misc. fish larvae	0.2	0.1	0.3				0.1						
Mollusca						0.1		0.9	0.1				
Callinectes juveniles						0.1				0.1			
Caprella	0.2							0.1					
Misc. shrimp			0.6										
Eggs		0.1		0.1									

Source: Reference 24

Table 16 Monthly abundance of zooplankters in experimental plankton tows, Ashley River, 1963-1964

CATCH PER UNIT OF EFFORT

Species, etc.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Organic detritus	11.7	21.8	1.9	1.2	12.3	2.5	6.9	4.0	55.8	71.0	8.4	4 5	44.3
Coelenterata	536.7	542.4	3180.7	1019.5	318.7	32.2	13.5	0.5	12.3	53.3	26.0	349.8	356.6
Ctenophora		1.0	1.5	1.5	12.7						0.6	14.0	0.7
Chaetognatha	120.0	2.5	79.4	20.9					0.3				1.0
Polychaeta											0.9	2 0	
Misc. worms			0.5	0.4			0.2					5.0	
Copepoda	443.7	53549.2	1166.6	382.2	5.1	2.4	0.5	0.3	23.2	43.7	127.8	67.8	54.3
Mysidacea	125.0	41.2	12.5	166.9	6.0	5.5	0.2	10.7	11.7	11.7	3.0	4.4	
Isopoda				0.4	0.7			0.3			0.7	0.1	0.3
Amphipoda	1.3	0.4	0.5	0.2		2.4		0.3	0.5	0.2	0.3		
Paleomonetes	3.0	0.5	1.2					1.2	1.3		0.2		
Paleomonetes larvae	69.7	8.2	5.5	11.5	3.0							15.6	14.3
Penaeid larvae	14.3	3.4	1.2	1.0		0.4				0.3	1.0		
Misc. shrimp larvae		5.5	68.3	0.6									1.7
Sergestidae	1.7	2.7	2.0	46.6									
Callinectes larvae	37.3	198.4	259.4	33.4							0.2	219.1	1213.0
Misc. crab larvae				215.9	19.0	1.0							
Stomatopoda				0.2									
Micropogon							0.2	1.0	6.5	0.3	0.3	0.5	0.3
Leiostomus								1.0	17.9	3.7	0.4		
Paralichthys								0.2	1.3				
Anchoa		0.4	0.2				1.0		1.5	0.3			8.3
Stellifer		0.4		0.7			1.0						
Brevoortia									0.7	1.0	0.7		
Eel larvae									0.7				
Lagodon								0.2	0.2				
Misc. fish larvae				2.0			0.2	0.2					
Mollusca			1.3		0.2								
Eggs				5.4							0.7	0.2	
Renilla						0.2							

Source: Reference 24

Table 17

Standing crops (catch per surface acre) of fishes and invertebrates in three Cooper River, South Carolina, tidal streams in April, July, and November 1971. Numbers of organisms are subtended by weights (pounds) in parentheses.

Organisms	Sampling Site											
	Clouter No. 1			Clouter No. 2			Bushy Park			Mean[1]		
	April	July	November	April	July	November	April	July	November	April	July	November
Fishes												
Lepisosteidae - gars												
Lepisosteus osseus, longnose gar		2 (5.6)			5 (13.5)				1 (0.1)		2 (6.4)	<1 (<0.1)
Amiidae - bowfins												
Amia calva, bowfin				1 (2.6)						<1 (0.9)		
Anguillidae - freshwater eels												
Anguilla rostrata, American eel	462 (10.3)	23 (2.0)	1 (0.3)	559 (6.5)	1,303 (108.0)	18 (1.5)	463 (14.5)	28 (2.5)	9 (1.0)	495 (10.4)	451 (37.5)	9 (0.9)
Clupeidae - herrings												
Alosa aestivalis, blueback herring			85 (0.4)			961 (5.1)			107 (0.2)			384 (1.9)
Alosa mediocris, hickory shad				1 (0.6)								
Brevoortia tyrannus, Atlantic menhaden	3,398 (3.1)	15,562 (33.8)	9 (<0.1)	22,464 (5.1)	21,421 (71.6)	5 (<0.1)	2 (<0.1)	7 (<0.1)		8,621 (2.7)	12,330 (35.1)	5 (<0.1)
Dorosoma cepedianum, gizzard shad	7 (0.4)		13 (1.3)	14 (0.2)	251 (1.1)	8 (2.3)	3 (0.2)	9 (0.5)	1 (0.7)	8 (0.3)	87 (0.5)	7 (1.4)
Dorosoma petenense, threadfin shad	2 (<0.1)			1 (<0.1)						1 (<0.1)		
Engraulidae - anchovies												
Anchoa mitchilli, bay anchovy			435 (0.1)	107 (0.3)		10,508 (22.3)			1,305 (0.3)	36 (0.1)		4,083 (7.6)
Esocidae - pikes												
Esox niger, chain pickerel								1 (<0.1)			<1 (<0.1)	
Cyprinidae - minnows and carps												
Cyprinus carpio, carp					2 (22.0)						<1 (7.3)	
Ictaluridae - freshwater catfishes												
Ictalurus catus, white catfish	379 (12.8)	521 (24.7)	1 (<0.1)	209 (4.0)	87 (6.5)	459 (30.4)		884 (5.0)	1 (0.3)	196 (5.6)	497 (12.1)	154 (10.2)
Belonidae - needlefishes												
Strongylura marina, Atlantic needlefish		9 (0.1)		2 (0.9)	1 (<0.1)	1 (0.4)		1 (<0.1)		<1 (0.3)	4 (<0.1)	<1 (0.1)
Cyprinodontidae - killifishes												
Fundulus heteroclitus, mummichog	869 (6.6)	21,476 (30.0)		4,580 (13.4)	3,964 (7.7)	806 (0.9)	850 (1.1)	3,805 (17.1)		2,100 (7.0)	9,748 (18.3)	269 (0.3)
Poeciliidae - livebearers												
Gambusia affinis, mosquitofish								2 (<0.1)			<1 (<0.1)	
Atherinidae - silversides												
Menidia beryllina, tidewater silverside		806 (1.8)	414 (0.1)	6 (<0.1)	806 (1.8)	1,636 (1.0)	1,235 (0.9)	12 (<0.1)	39 (<0.1)	414 (0.3)	541 (1.2)	696 (0.4)
Menidia menidia, Atlantic silverside	1 (<0.1)	1,936 (1.8)								<1 (<0.1)	645 (0.6)	
Syngnathidae - pipefishes and seahorses												
Syngnathus fuscus, northern pipefish			1 (<0.1)									<1 (<0.1)
Centropomidae - snooks												
Centropomus undecimalis, snook						1 (<0.1)						<1 (<0.1)
Percichthyidae - temperate basses												
Morone saxatilis, striped bass			1 (0.5)			1 (0.8)						1 (0.4)
Centrarchidae - sunfishes												
Enneacanthus gloriosus, bluespotted sunfish			1 (<0.1)			15 (0.3)			1 (<0.1)			6 (0.1)
Lepomis auritus, redbreast sunfish									4 (1.2)			1 (0.3)
Lepomis gibbosus, pumpkinseed							23 (2.3)		3 (0.3)	8 (0.8)		1 (0.1)

Table 17 (Con't)

Organisms	Sampling site: Clouter No. 1			Clouter No. 2			Bushy Park			Mean		
	April	July	November	April	July	November	April	July	November	April	July	November
Fishes												
Lepomis macrochirus, bluegill						1 (<0.1)		2 (<0.1)			<1 (<0.1)	<1 (<0.1)
Lepomis microlophus, redear sunfish							1 (<0.1)	1 (<0.1)		<1 (<0.1)	<1 (<0.1)	
Lepomis punctatus, spotted sunfish	1 (<0.1)						1 (0.1)	16 (0.6)		<1 (<0.1)	<1 (0.2)	
Micropterus salmoides, largemouth bass			1 (0.1)	1 (0.1)	23 (3.2)	3 (0.8)	6 (1.3)	421 (3.1)	11 (3.3)	2 (0.5)	148 (2.1)	5 (1.4)
Pomoxis annularis, white crappie	3 (0.1)		18 (1.8)	24 (0.7)	47 (1.3)		14 (0.3)	5 (0.5)	9 (0.9)	14 (0.4)	10 (0.4)	9 (0.9)
Percidae - perches Perca flavescens, yellow perch				4 (0.2)	3 (0.3)	2 (1.0)	6 (0.2)	14 (0.5)	4 (0.4)	3 (0.1)	6 (0.3)	2 (0.5)
Pomatomidae - bluefishes Pomatomus saltatrix, bluefish					3 (0.1)						1 (<0.1)	
Carangidae - jacks and pompanos Caranx hippos, crevalle jack			6 (0.1)			20 (0.6)			1 (<0.1)			9 (0.2)
Clupeidae - herrings Dorosoma cepedianum, gizzard shad												
Engraulidae - anchovies Anchoa mitchilli, bay anchovy												
Cyprinodontidae - killifishes Fundulus heteroclitus, mummichog												
Mugilidae - mullets Mugil cephalus, striped mullet	2,053 (36.3)	1,228 (9.8)	4 (1.4)	1,582 (36.8)	35 (4.4)	22 (4.2)	830 (22.7)	24 (2.2)	2 (0.3)	1,488 (31.9)	429 (5.5)	9 (2.0)
Gobiidae - gobies Evorthodus lyricus, lyre goby								2 (<0.1)			<1 (<0.1)	
Gobiomellus hastatus, sharptail goby								3 (<0.1)	1,218 (0.6)		1 (<0.1)	406 (0.2)
Gobionellus shufeldti, freshwater goby	1 (<0.1)	37 (0.1)	1,212 (0.2)	2,121 (4.7)	889 (3.8)		2,035 (2.7)	3,282 (4.7)		1,386 (2.5)	1,403 (2.9)	404 (<0.1)
Gobiosoma bosci, naked goby				1,081 (2.4)	403 (0.1)	416 (0.2)	1 (<0.1)	397 (0.1)		361 (0.8)	267 (<0.1)	139 (<0.1)
Bothidae - lefteye flounders Etropus crossotus, fringed flounder		9 (0.1)						2 (0.1)			4 (<0.1)	
Paralichthys dentatus, summer flounder			1 (0.1)			1 (0.3)			1 (0.1)			1 (0.2)
Paralichthys lethostigma, southern flounder	7 (0.5)	1 (<0.1)		2,922 (1.5)	9 (0.2)		1,220 (0.9)	9 (0.2)		1,383 (1.0)	6 (0.2)	
Soleidae - soles Trinectes maculatus, hogchoker					1 (<0.1)		1 (<0.1)	1 (<0.1)	1 (<0.1)	<1 (<0.1)	<1 (<0.1)	<1 (<0.1)
Total fishes (45 species)	26,738 (99.9)	44,551 (118.3)	5,066 (7.3)	111,133 (167.0)	35,538 (257.1)	17,983 (74.9)	9,138 (49.1)	8,938 (37.7)	2,802 (10.4)	49,003 (102.0)	29,676 (137.7)	8,617 (30.9)
Invertebrates												
Palaemonidae - grass shrimps Palaemonetes pugio, grass shrimp	50,860 (24.7)	357,416 (247.7)	4,039 (0.4)	307,312 (122.0)	980,016 (663.3)	334,093 (104.8)	56,177 (13.1)	10,093 (2.0)	2 (<0.1)	138,116 (53.3)	449,175 (304.3)	112,711 (35.1)
Penaeidae - penaeid shrimps Penaeus setiferous, white shrimp		11,759 (13.5)	481 (2.1)		50,668 (61.5)						20,809 (25.0)	160 (0.7)
Portunidae - swimming crabs Callinectes sapidus, blue crab	1,635 (94.6)	15 (1.2)	1,216 (1.1)	2,761 (3.1)	8,151 (32.4)	809 (1.4)	1,638 (30.4)	425 (1.9)	2 (0.7)	2,011 (42.7)	2,864 (11.8)	676 (1.1)
Total invertebrates (3 species)	52,495 (119.3)	369,190 (262.4)	5,736 (3.6)	310,073 (125.1)	1,038,835 (757.2)	334,902 (106.2)	57,815 (43.5)	10,518 (3.9)	4 (0.7)	140,127 (96.0)	472,848 (341.2)	113,547 (36.8)
Total organisms (48 species)	79,233 (219.2)	413,741 (380.7)	10,802 (10.9)	421,206 (292.1)	1,074,373 (1,014.3)	352,885 (181.1)	66,953 (92.6)	19,456 (41.6)	2,806 (11.1)	189,131 (201.3)	502,523 (478.9)	122,164 (67.7)

[1]Slight discrepancies in totals due to rounding of mean values.

Source: South Carolina Water Resources Commission

Table 18

Species Composition of Fish Captured in Charleston Harbor Dumping Area

Family & Species	No. of Specimens	Length Range (mm)
Carcharhinidae		
Mustelus canis	1	641
Rajidae		
Raja eglanteria	1	477
Engraulidae		
Anchoa hepsetus	12	100-119
Synodontidae		
Synodus foetens	144	140-339
Ogcocephalidae		
Ogcocephalus	1	59
Gadidae		
Urophycis regius	1	188
Syngnathidae		
Centropristis striata	12	71-182
Diplectrum formosum	1	91
Carangidae		
Caranx crysos	1	164
Decapterus macarellus	10	122-144
Decapterus punctatus	4	133-173
Lutjanidae		
Lutjanus analis	8	76-126
Gerreidae		
Eucinostomus argenteus	1	90
Eucinostomus gula	1	78
Pomadasyidae		
Orthopristis chrysoptera	1	122
Sparidae		
Stenotomus caprinus	18	75-120
Lagodon rhomboides	3	105-118
Scianidae		
Bairdiella chrysura	1	140
Leiostomus xanthurus	10	135-155
Trichiuridae		
Trichiurus lepturus	1	216
Stromateidae		
Peprilus triacanthus	50	105-144

Table 18 (Cont'd)

Triglidae		
Prionotus evolans	3	103-118
Prionotus scitulus	9	101-121
Bothidae		
Ancyclopsetta quadrocellata	4	146-199
Citharichthys spilopterus	26	53-81
Scophthalmus aquosus	1	119
Balistidae		
Balistes capriscus	1	122
Monocanthus hispidus	1	54

Total No. 328

Source: South Carolina Wildlife and Marine Resources Dept.

Table 19

SPECIES COMPOSITION OF BENTHIC AND FREE-SWIMMING INVERTEBRATES CAPTURED IN CHARLESTON HARBOR DUMPING AREA.

	UNCOMMON	COMMON	ABUNDANT
Portunidae			XXX
Cancridae	X		
Maiidae	X		
Paguridae		XX	
Xiphosura	X		
Squillidae		XX	
Loliginidae			XXX
Holothuroidea	X		
Echinoidea		XX	
Asteroidea		XX	
Ophiuroidea		XX	
Gastropoda		XX	
Pelecypoda	X		
Chaetopoda	X		
Entoprocta		XX	
Anthozoa		XX	
Amphineura	X		
Cirripedia	X		

Source: South Carolina Wildlife and Marine Resources Dept.

Table 20

EXPORTS BY COUNTY, SOUTH CAROLINA, 1972
(tons)
(break-bulk cargo only)*

County	Tonnage	County As Percentage Of State Total
Abbeville	0.0	0.00%
Beaufort	0.0	0.00
Calhoun	0.0	0.00
Fairfield	0.0	0.00
Jasper	0.0	0.00
McCormick	0.0	0.00
Saluda	0.0	0.00
Edgefield	0.6	0.00
Horry	1.6	0.00
Lee	1.9	0.00
Hampton	7.3	0.00
Colleton	9.2	0.00
Williamsburg	9.6	0.00
Union	28.0	0.02
Marion	28.5	0.02
Oconee	41.5	0.03
Newberry	42.9	0.03
Bamberg	48.7	0.03
Kershaw	53.8	0.03
Chesterfield	63.3	0.04
Laurens	76.1	0.05
Marlboro	76.8	0.05
Sumter	77.?	0.05
Cherokee	81.5	0.05
Darlington	92.9	0.06
Dillon	118.8	0.07
Lexington	121.0	0.08
Clarendon	136.0	0.09
Dorchester	196.5	0.12
Barnwell	229.6	0.14
Lancaster	310.3	0.20
Pickens	366.6	0.23
Greenwood	430.9	0.27
Anderson	840.3	0.53
Berkeley	903.3	0.57
Florence	1,301.0	0.82
Allendale	1,402.1	0.88
Spartanburg	2,266.5	1.42
Chester	2,628.6	1.65
Richland	2,974.2	1.87
Greenville	6,426.5	4.04
Orangeburg	14,410.0	9.06
Georgetown	14,544.0	9.14
Aiken	18,073.0	11.36
Charleston	21,771.0	13.68
York	68,933.0	43.32
TOTAL TONS	159,126.0	100.00%

Source: SCSPA

*Does not include bulk or container cargo.

Table 21

IMPORTS BY COUNTY, SOUTH CAROLINA, 1972
(tons)
(break-bulk cargo only)*

County	Tonnage	County As Percentage Of State Total
Cherokee	0.0	0.00%
Jasper	0.0	0.00
McCormick	0.0	0.00
Calhoun	5.8	0.00
Newberry	25.4	0.01
Beaufort	82.5	0.03
Fairfield	85.1	0.03
Lee	91.1	0.03
Dorchester	149.0	0.05
Marion	175.4	0.06
Williamsburg	178.8	0.06
Oconee	216.0	0.07
Lancaster	245.2	0.08
Saluda	276.5	0.09
Greenwood	334.7	0.11
Chester	375.8	0.12
Pickens	511.8	0.17
Horry	713.6	0.23
Clarendon	779.1	0.25
Laurens	829.8	0.27
Allendale	834.7	0.27
Edgefield	902.4	0.29
Marlboro	1,138.3	0.37
Barnwell	1,490.3	0.49
Colleton	1,717.8	0.56
Darlington	1,791.4	0.58
Union	2,322.6	0.76
Berkeley	2,913.8	0.95
Kershaw	2,968.9	0.97
Anderson	3,080.7	1.00
Chesterfield	4,068.4	1.33
Hampton	4,238.6	1.38
Abbeville	4,455.8	1.45
Aiken	4,873.1	1.59
Dillon	5,447.7	1.76
Sumter	7,750.7	2.53
Bamberg	8,346.0	2.72
Georgetown	8,346.0	2.72
Lexington	8,514.3	2.76
Spartanburg	9,168.2	2.99
York	13,684.0	4.46
Florence	17,639.0	5.75
Greenville	30,444.0	9.92
Richland	38,174.0	12.44
Orangeburg	39,357.0	12.83
Charleston	78,018.0	25.43
TOTAL TONS	306,760.0	100.00%

Source: SCSPA.

*Does not include bulk or container cargo.

Table 22

VALUE OF EXPORTS BY COUNTY, SOUTH CAROLINA, 1972
(break-bulk cargo only)*

County	Value	County As Percentage Of State Total
Abbeville	$ 0	0.00%
Beaufort	0	0.00
Calhoun	0	0.00
Fairfield	0	0.00
Jasper	0	0.00
McCormick	0	0.00
Saluda	0	0.00
Horry	248	0.00
Edgefield	1,140	0.00
Williamsburg	1,344	0.00
Lee	3,610	0.00
Bamberg	9,638	0.01
Marion	18,240	0.02
Clarendon	19,040	0.02
Hampton	20,440	0.02
Colleton	25,400	0.02
Kershaw	33,998	0.03
Chesterfield	43,130	0.04
Dillon	46,956	0.05
Dorchester	47,750	0.05
Union	53,200	0.06
Newberry	55,264	0.06
Sumter	63,202	0.07
Darlington	66,587	0.07
Lexington	78,822	0.08
Oconee	79,210	0.09
Barnwell	88,648	0.10
Laurens	145,220	0.16
Marlboro	148,620	0.16
Cherokee	154,850	0.17
Berkeley	456,814	0.51
Lancaster	589,570	0.66
Greenwood	734,010	0.83
Richland	860,754	0.97
Pickens	1,017,652	1.15
Chester	1,603,126	1.81
Anderson	1,892,503	2.14
Allendale	2,088,470	2.36
Orangeburg	2,097,805	2.37
Florence	2,320,794	2.62
Spartanburg	4,066,373	4.60
Aiken	8,006,183	9.07
York	10,112,380	11.45
Greenville	12,513,837	14.17
Georgetown	17,002,235	19.26
Charleston	21,707,144	24.59
TOTAL	$88,274,207	100.00%

*Does not include bulk or container cargo.

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